JULY 12, 1984

MICROCOMPUTER WORLD NERVOUSLY AWAITS IBM'S PC II/83

Fast 32-bit Futurebus anticipates new architectures/108

Active matrix addressing improves flat-panel displays/113

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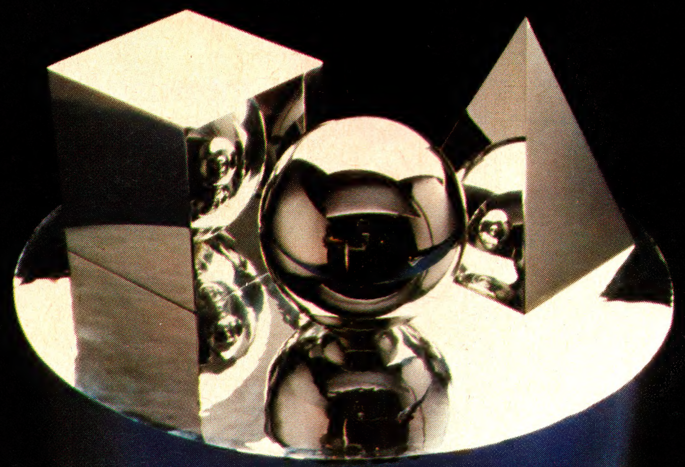

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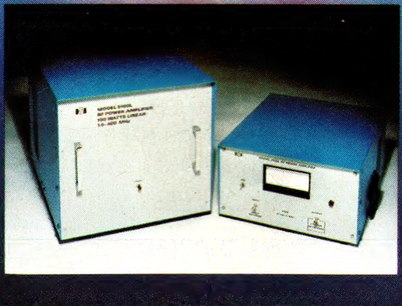

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Vol. 57, No. 14 • July 12, 1984

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The Cover Story

64-bit chip set devours floating-point data

Engineering and scientific *work stations and digital signal-processing applications are among the uses for floating-point addition and multiplication chips. Some jobs, such as simulations of complex circuitry, require double-precision accuracy to produce meaningful results.*

A high-speed double-precision *capability now comes with chips that build one-board arithmetic accelerators and can be ganged in multiples for better performance, 99*

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Highlights

Experts suspect IBM may enter supercomputer market, 45

IBM Corp. will neither confirm nor deny rumors that it may be planning to enter the supercomputer business. Experts' eyebrows were raised after the computer giant unveiled an off-the-shelf design for parallel processing to a group of supercomputer users at the end of June. Causing speculation is a configuration that "amounts to the simple and obvious evolution of standard equipment," according to the man who conceived the project. Moreover, this development embodies a recent trend: connecting array processors and computers to form inexpensive systems.

Futurebus uses asynchronous protocol to meet needs of future, 108

To design a 32-bit backplane bus, an IEEE committee had to develop a parallel protocol that could reliably transmit 32 bits of data between two or more bus modules at the highest possible rate, use any microprocessor architecture, and provide "hooks" for multiprocessor operation. To do the job, the committee chose an asynchronous rather than a synchronous protocol. Far from being inferior to synchronous protocols, a correctly applied asynchronous protocol proves a superior general backplane bus.

Technique of modifying pc boards cuts costs drastically, 52

A new technique makes it easier and cheaper to modify printed-circuit boards, a necessary capability despite the proliferation of computer-aided-design tools. But the usual method—hand wiring and soldering in—is laborious, time consuming, and expensive. Furthermore, it often leads to wiring errors. Additive Technology Corp.'s process, which cuts costs by 30% to 40%, deposits wiring changes onto an added-on insulation layer that is placed over existing printed wiring.

What's ahead....

Megabit dynamic RAMs: In fast-paced memory technology, designers of very large-scale-integration parts are already defining the packaging, operational, and technological characteristics of next-generation 1-megabit dynamic random-access memories. . . .**July 23.**

World Market Forecast: As end-user buying sprees continue, the prospects for the electronics industries in the U. S., Western Europe, and Japan look bright for the remainder of 1984. In fact, U. S. manufacturers are riding the crest of their best year in the last 10. . . .**July 23.**

Personal computer update: A special report will update the latest advances in personal computer technology, including the new types of substrates, thermoplastic boards, improved resists, and line automation. . . .**July 30.**

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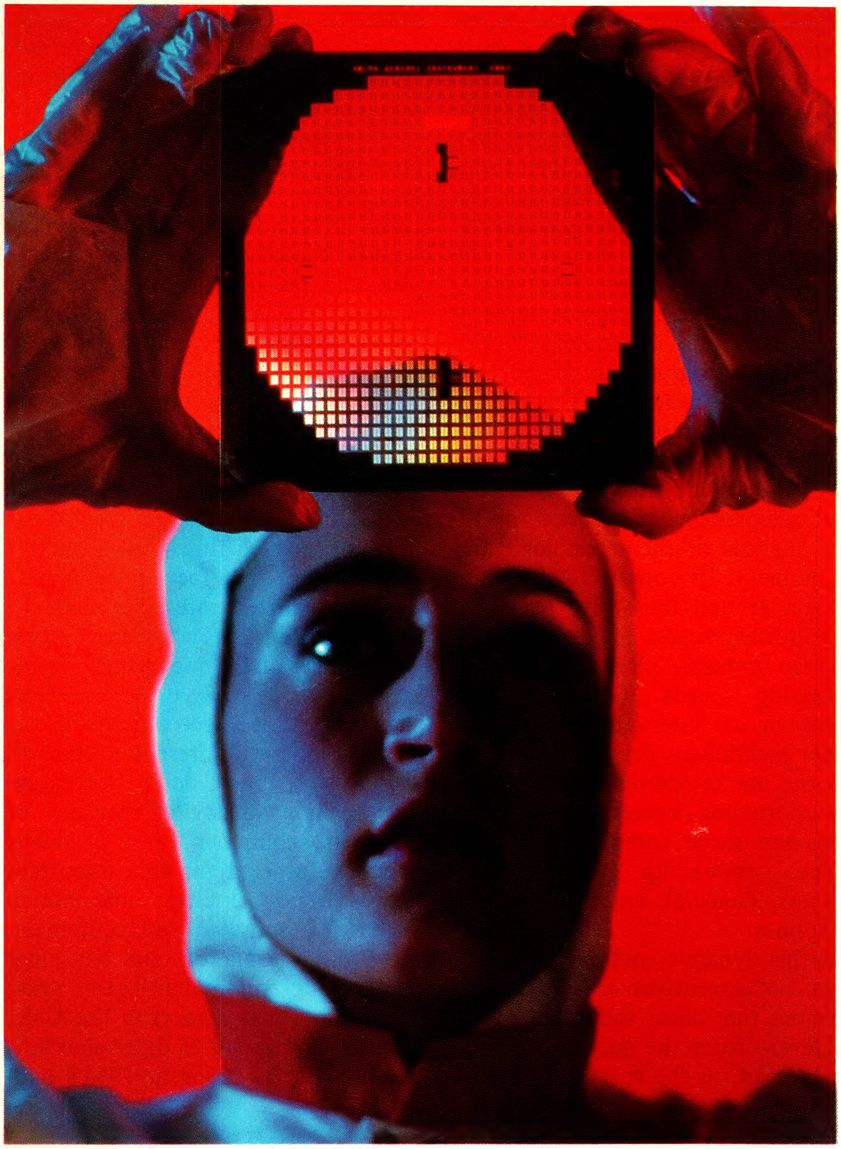

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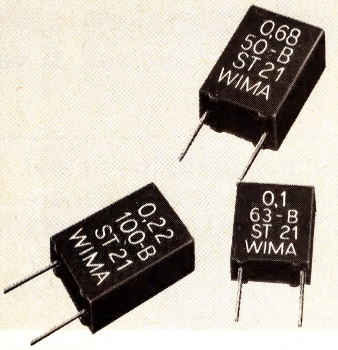

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Editor's letter

On July 23, 1984, *Electronics* will begin publishing on a weekly basis and will change its name to *ElectronicsWeek.*

This evolution carries on our tradition of staying in touch with change in the industry we serve. And it is intended to make us better able to meet the information needs of our readers, a tradition that has driven *Electronics* for 54 years, ever since McGraw-Hill launched the publication with an ambitious, forward-looking charter to provide readers with a focused view of a then-fledgling industry. It did its job well—so well that the new technology and the industry it spawned embraced the new word on the cover: *Electronics.*

Since then, the electronics industry has evolved into a dynamic, worldwide force encompassing virtually all business and industry. Throughout this past half century, *Electronics* has maintained the charter of its first editors: to provide readers with the most comprehensive, accurate, up-to-date analysis of the technology and the industry. Its current 102,000 subscribers around the world testify to its editorial success in keeping pace with an industry changing at ever-increasing speeds. Today's reader works in an international industry where technology drives the market and the market drives technology in ever-shortening cycles. Information needs are more complex than ever before, embracing technological, business, financial, and management disciplines.

In this dynamic environment, engineers and executives are faced with decisions that affect the future at every level—from the success of a design project, to the success or failure of entire companies, to advancing their own careers. Their success depends directly on the availability of complete, accurate, analytical, and timely information.

These are the reasons for our decision to begin publishing weekly under a new name. The *Electronics* in the name reflects our continuing commitment to cover this important and vital industry with the same degree of insight and dedication that we have maintained for 54 years, while the added *Week* recognizes the increasing volatility of technology and the marketplace, imposing on us the responsibility for providing information more frequently. Thus, *ElectronicsWeek* will be the only weekly magazine devoted entirely to covering the international electronics industry and its impact on the world's industrial community.

With its new frequency, *ElectronicsWeek* will bring more focus to individual areas of technology and the marketplace and will allow us to add coverage to an already comprehensive editorial package. We will continue to bring to our readers the quality reporting, the detailed articles, and the insightful analysis that have made *Electronics* the most influential, definitive, and relied-upon publication in the field.

As part of our commitment to retain quality while expanding our coverage, we are augmenting our staff with the best technical journalists we can find. In addition, the format has been redesigned into an attractive new package that focuses our coverage, reorganizes categories and departments, and provides easy access to all parts of the magazine.

To inaugurate *ElectronicsWeek*, the first issue will present a state-of-the-industry report on the forces operating in a variety of markets for electronic equipment and products. Markets targeted for this important special report include information processing, software, test equipment, industrial automation, and consumer goods. Our editors have been interviewing business leaders in the U. S., Europe, and Japan to determine how the industry is faring at 1984's halfway point.

From early reports, it looks as if 1984 will be a boom year for just about all suppliers in the electronics business. The atmosphere is understandably heady, as users' pocketbooks are heavier following the recession of 1980-82. Our report examines which products are moving and which ones are not. Electronics business leaders themselves will detail the reasons for these successes and failures. □

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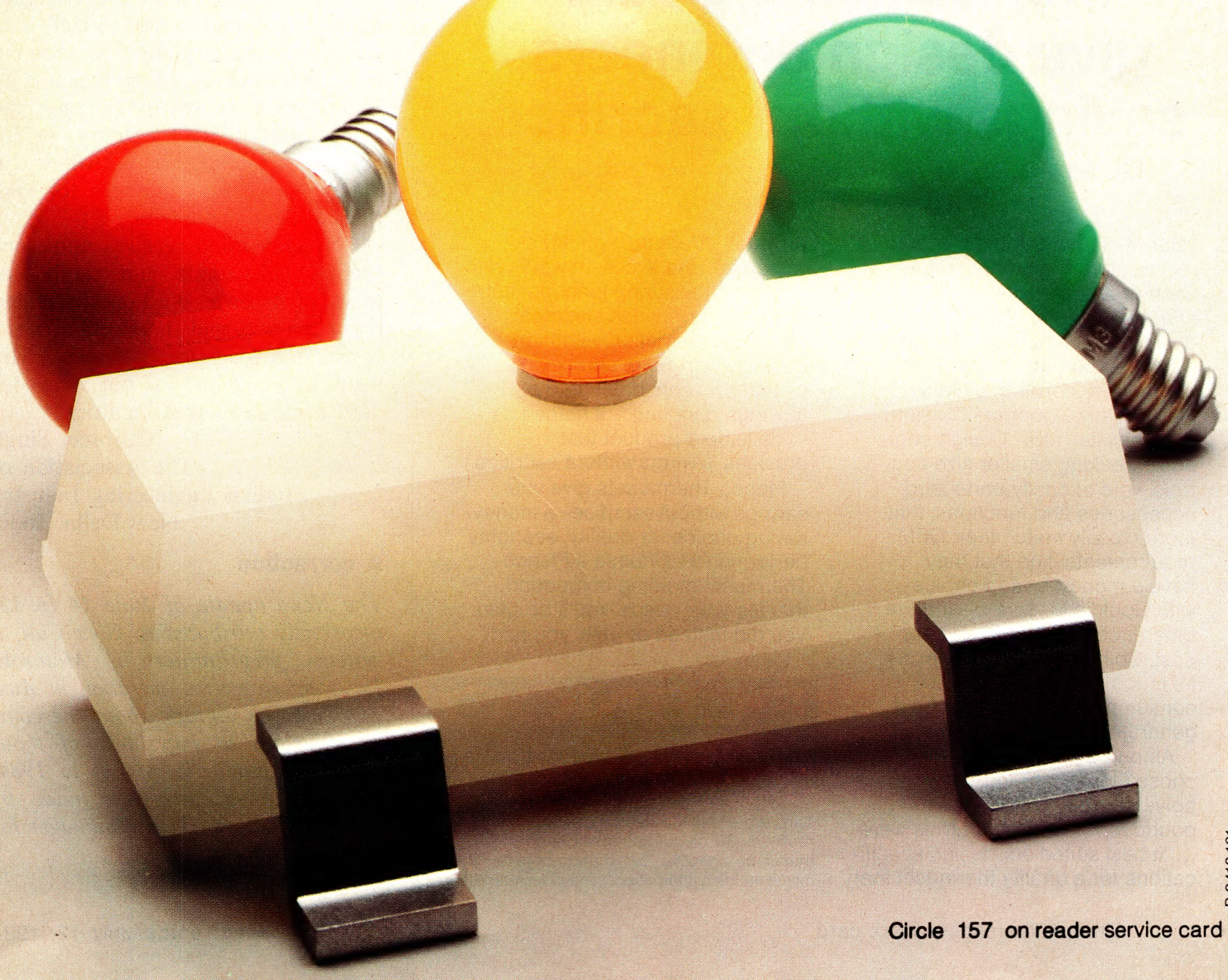

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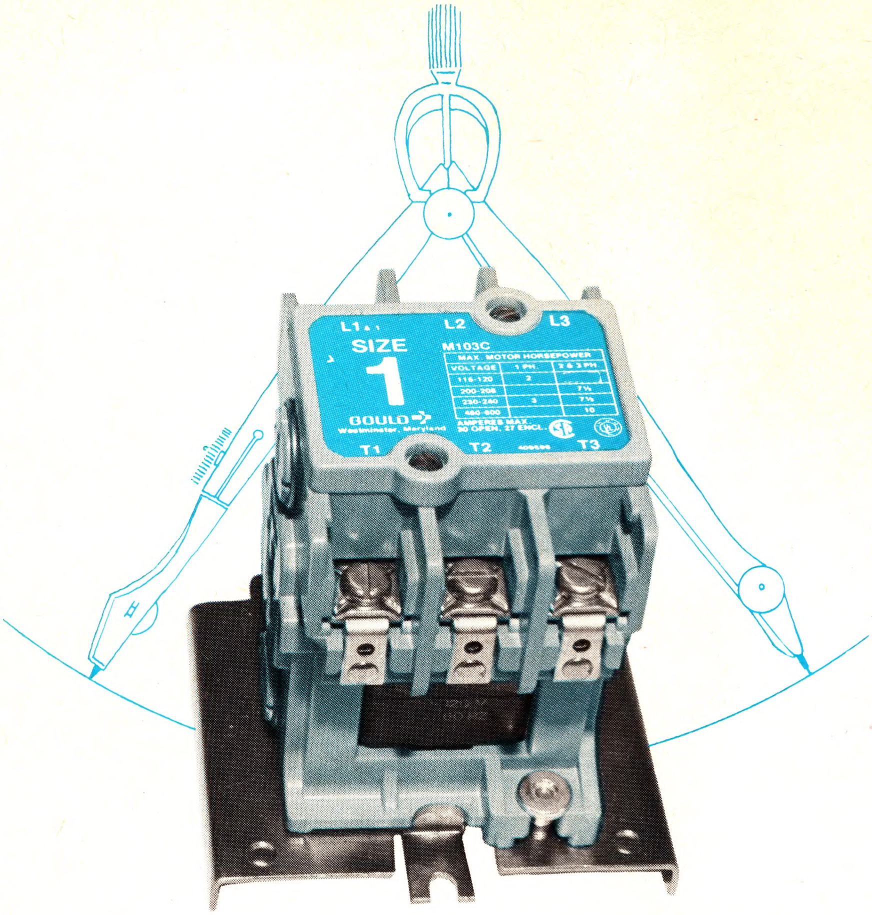

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Readers' comments

Indian opportunities

To the Editor: The Association of Indian Engineering Industry (AIEI) is the apex of Indian engineering. It has on its rolls about 1,700 companies, coming both from the public and the private sector, that produce goods and services whose value amounts to some $16.6 billion (U. S.). These companies represent 63% of the country's engineering production, 76% of its engineering exports, and 53% of its engineering employment opportunities.

The association, with its 11 offices in India and 2 overseas, has several facets. We organize engineering trade fairs, workshops, and seminars on technology. We influence governmental and industrial policy. We host conventions and conferences. We render engineering services. And we try to improve the interaction within the industry and between it and the government.

I am writing this letter to make your readers aware of the existence of this national body, which can serve as a useful vehicle for companies interested in doing business in India. We can set up meetings for associations in your country, or for companies looking for partners in India or for Indian partners for ventures in third countries.

The association receives numerous foreign delegations and sends out many of its own. We hope to extend these contacts and therefore offer the association's services to those who want to make use of our extensive data bank and other facilities.

Gurpreet Singh
The Association of
Indian Engineering Industry
New Delhi, India

A correction

The News update of June 14 [p. 32] incorrectly attributed to Glen Call, a systems programmer in Motorola Inc.'s microsystems operation in Austin, Texas, a remark about the company's plans to ship "tens of thousands" of bubble memories in 1984. In fact, the remark was made by Leonard Call, marketing manager for bubble memories.

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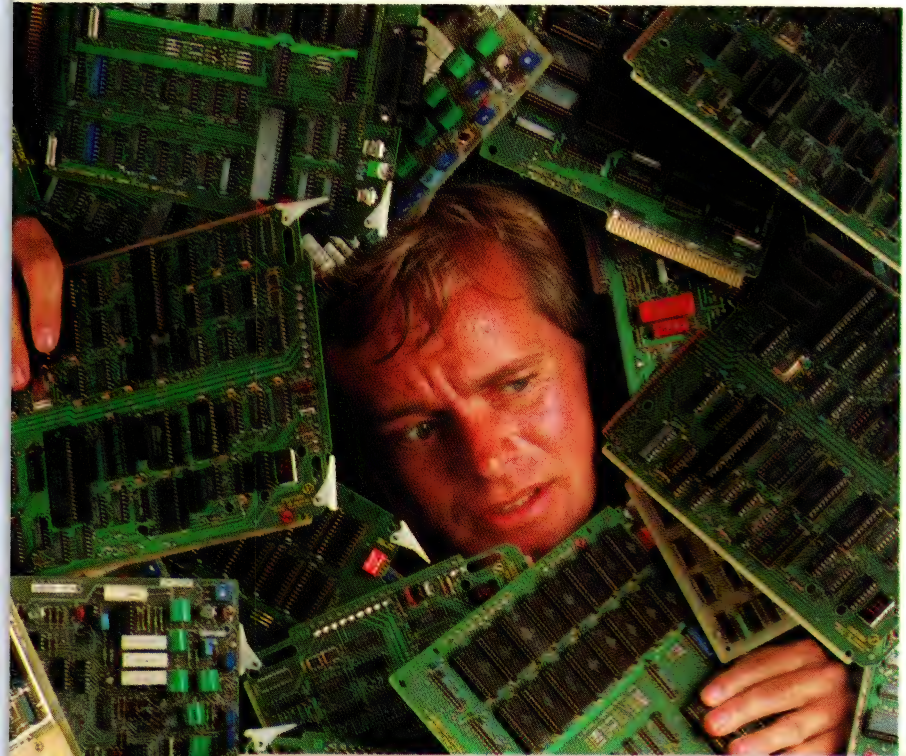

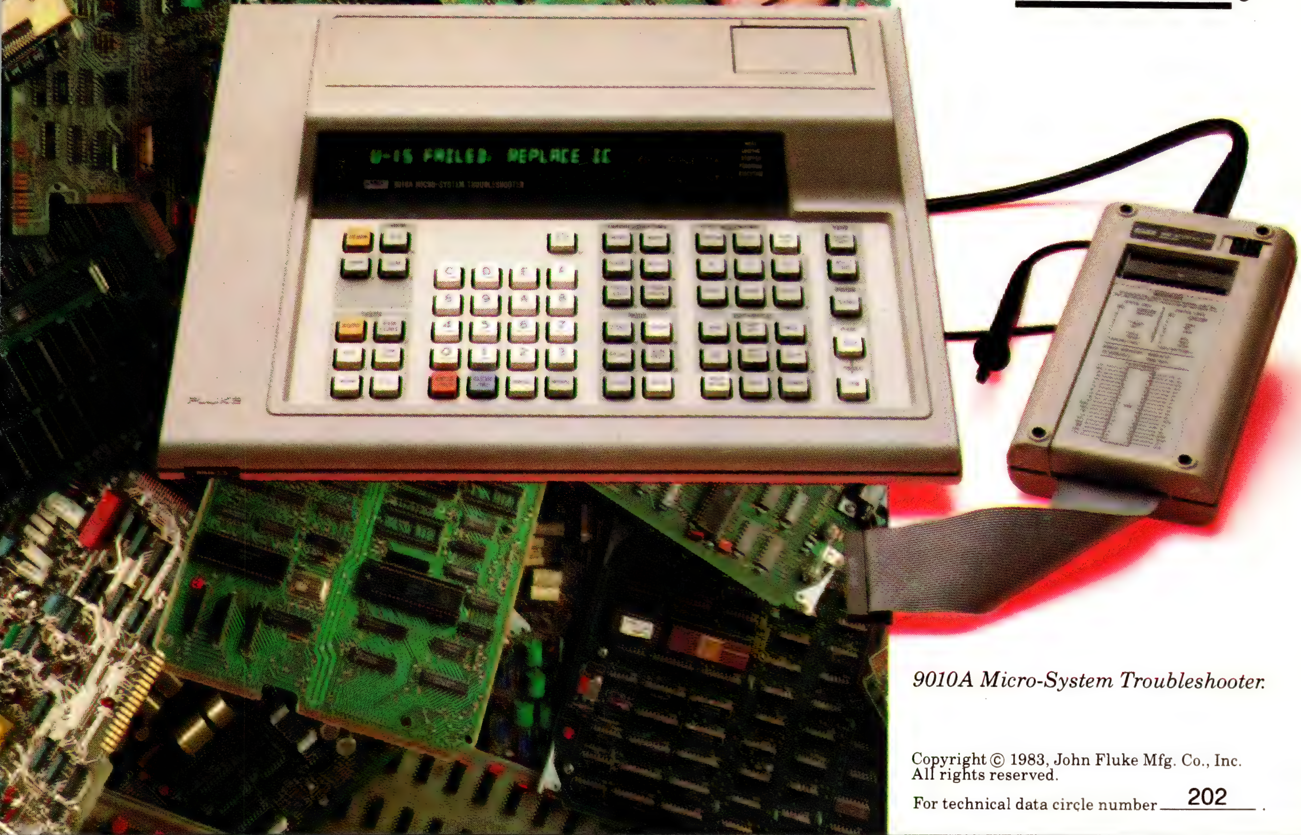

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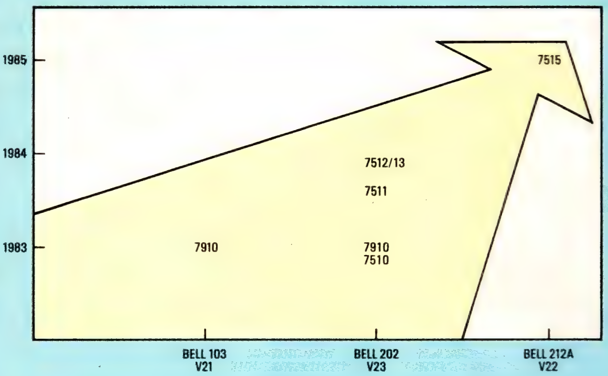

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EFG 7515
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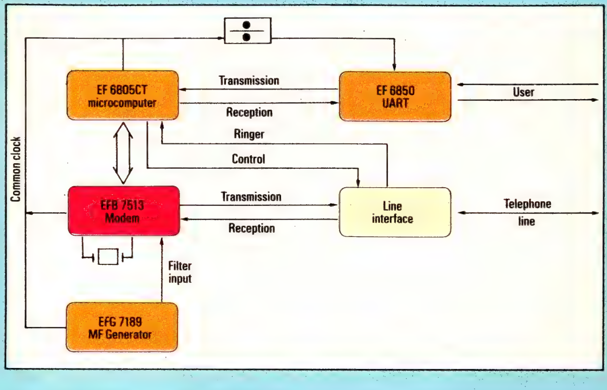

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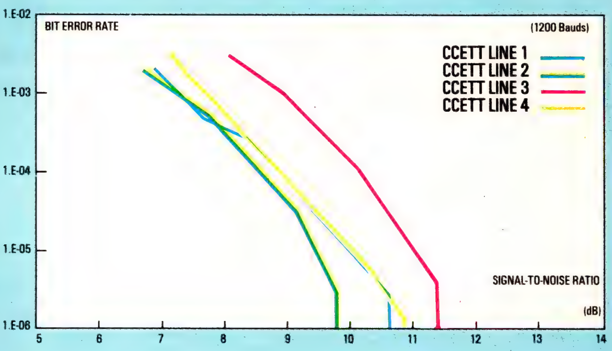

COMMUNICATION PERFORMANCE: EFB 7512

Typical error rate measured at 1200 Bauds for EFB 7512 on lines representative of the French network (CCETT 1, 2, 3, 4) in compliance with CCITT Recommendation V 52. Tests conducted in Thomson Semiconductors laboratory in Grenoble. Identical measurements are conducted for lines representing the Italian network (SIP 1, 2, 3, 4), the British network (BS 6305), the German network (FTZ) and the American network (FCC lines 3002 C1, C2, C3, C4 conditioning).

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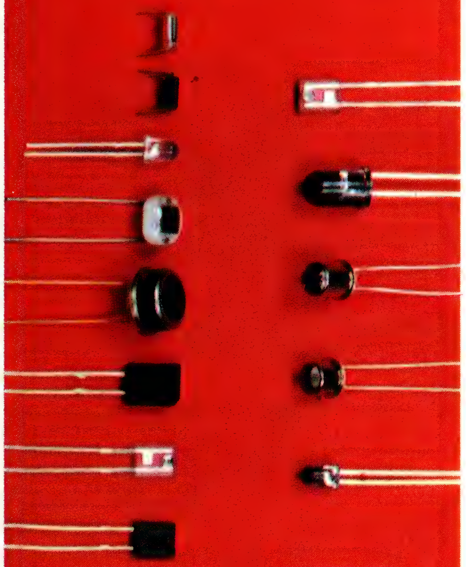

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People

Finn pilots Sony into the U. S. OEM business

The cost of developing consumer products is growing exponentially, says Kevin Finn, recently appointed vice president and general manager of Sony Corp. of America's new Components Products division, making it the right time for the Japanese parent firm to identify industrial applications in the U. S. Hence Sony created the division, in Paramus, N. J., and entered the market for original-equipment manufacturers.

Half the business. Kevin Finn says Sony aims to get 50% of its sales from components by 1990.

Finn believes he has the training necessary to navigate the rough seas of the OEM market. He has considerable experience in the OEM field, having spent 15 years with TRW Inc., Los Angeles, where he headed the semiconductor division from 1979. Before then, Finn was general manager of TRW's semiconductor operation in Bordeaux, France. Before joining TRW, he held design-engineering positions with ITT Semiconductors and with RCA Corp.'s Electronic Components division. He holds a BA degree in physics from Marist College, Poughkeepsie, N. Y., and completed the University of California at Los Angeles' Executive Program in Management, besides taking courses at the Harvard School of Business. And he is an avid sailor.

Sony's goal, says Finn, is to get 50% of its sales from components by 1990. To do that, the components division will focus on four major areas: data products such as microfloppy and hard-disk drives, display products such as cathode ray tubes and high-resolution color monitors, image-sensing products such as charge-coupled-device cameras and miniaturized video-system components, and semiconductor products, including MOS and bipolar technologies.

Sony's most notable contribution to the OEM market thus far is a 3½-inch microfloppy-disk drive and the cartridge-like disk it uses, notes Finn. Apple uses the drive in both the Macintosh and the Lisa II, as does Hewlett-Packard in its 150 Touchscreen computer.

The new vice president emphasizes that Sony has built four semiconductor plants and will add new facilities this year. "Going into the semiconductor business is not new for Sony," he stresses. Besides semiconductors, Finn says, Sony thinks it can get a foothold in display graphics with the Trinitron, a product it is currently customizing for the general avionics market.

Sony's strategy will be to develop interfaces between the industry and engineers, explains Finn. "My job will be to minimize the number of interfaces." For fiscal 1984, he projects that Sony's OEM business will be in the $200-million-to-$500-million range, an estimate that he admits is less than definitive.

DiGesualdo bringing up fab line for AMD in the heart of Texas

They proudly call it AMD's Texas tilt: with it, the Sunnyvale, Calif., chip merchant is establishing a noticeable presence in Austin, in the center of the Lone Star state. And Advanced Micro Devices Inc. is also relying heavily on a recently appointed vice president, who a decade ago

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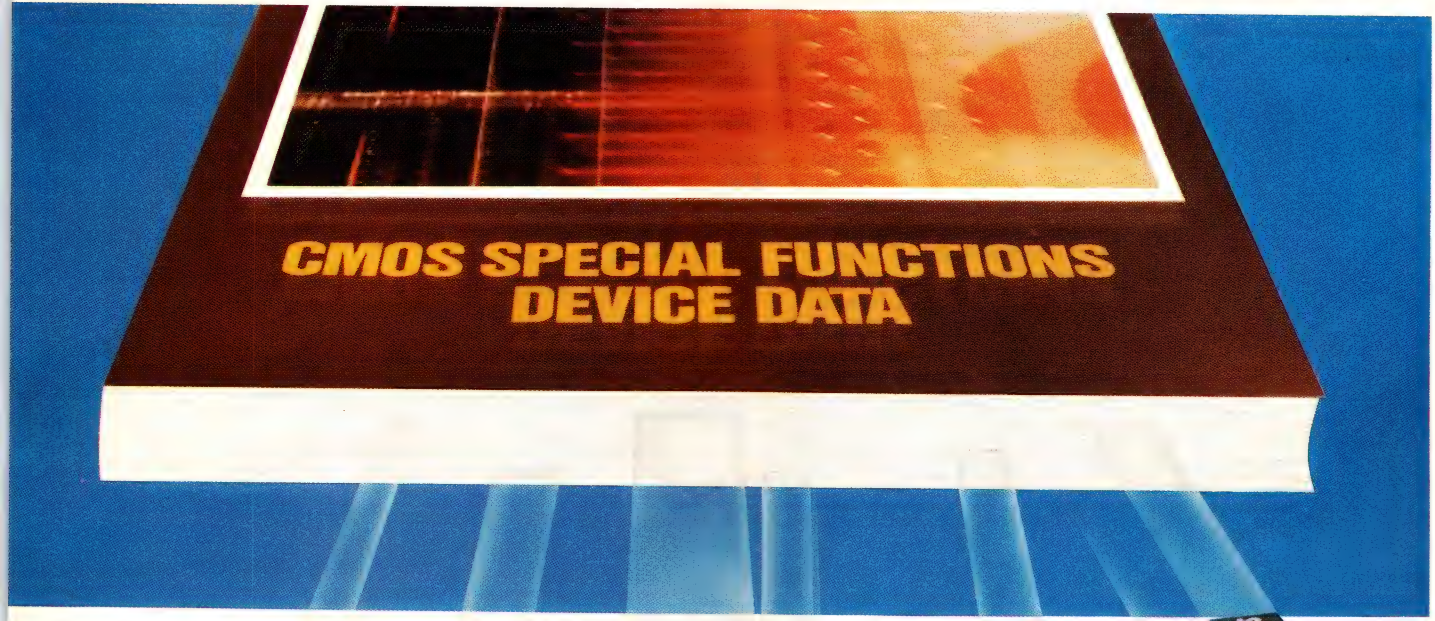

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started up Motorola Inc.'s first complementary-MOS fabrication line in Texas.

Now a six-year veteran with AMD, 45-year-old Frank DiGesualdo has built an industry reputation on bringing up semiconductor lines in new locations. After Motorola, he joined RCA Corp. in the mid-1970s, converting a computer-assembly plant in Palm Beach Gardens, Fla., into a chip-making operation.

DiGesualdo, who has directed AMD's production build-up in Texas since it began in 1979, was promoted in May to the new position of vice president of MOS-wafer-fabrication operations. A native of West Virginia, he received a BSEE from Evansville College, in Indiana, and an MBA from Florida Atlantic University, in Boca Raton.

Starting in the early 1970s, Austin began acquiring a different flavor, notes DiGesualdo. He says it has clearly shifted from a town totally dependent on government-related jobs (university, Air Force, state, and Federal) to a high-technology-manufacturing hub.

The rapid electronics growth in the Texas Hill Country has been in the forefront of the changes in Austin, but as is the case in other places, "engineers and technicians are getting harder to find each day," says DiGesualdo. "Aggravating the situation in the industry is the fact that equipment deliveries keep stretching out."

In order to cope with the hiring and equipment predicament, AMD is bringing up its three new Austin production lines in stages, stretched over an 18-month period. A new 322,000-square-foot wafer-fabrication and -test facility—which will make both n-channel and C-MOS parts—is now being equipped for production to begin this summer.

Already, AMD's Austin employment stands at 1,300 people and will hit 2,000 by year's end, says DiGesualdo. That, coupled with AMD's bipolar operation build-up 60 miles south in San Antonio, is expected to eventually place more than half of the fast-growing company deep in the heart of Texas.

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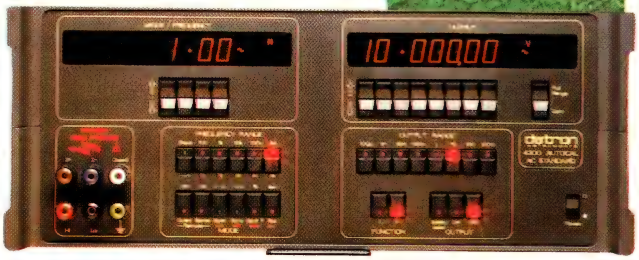

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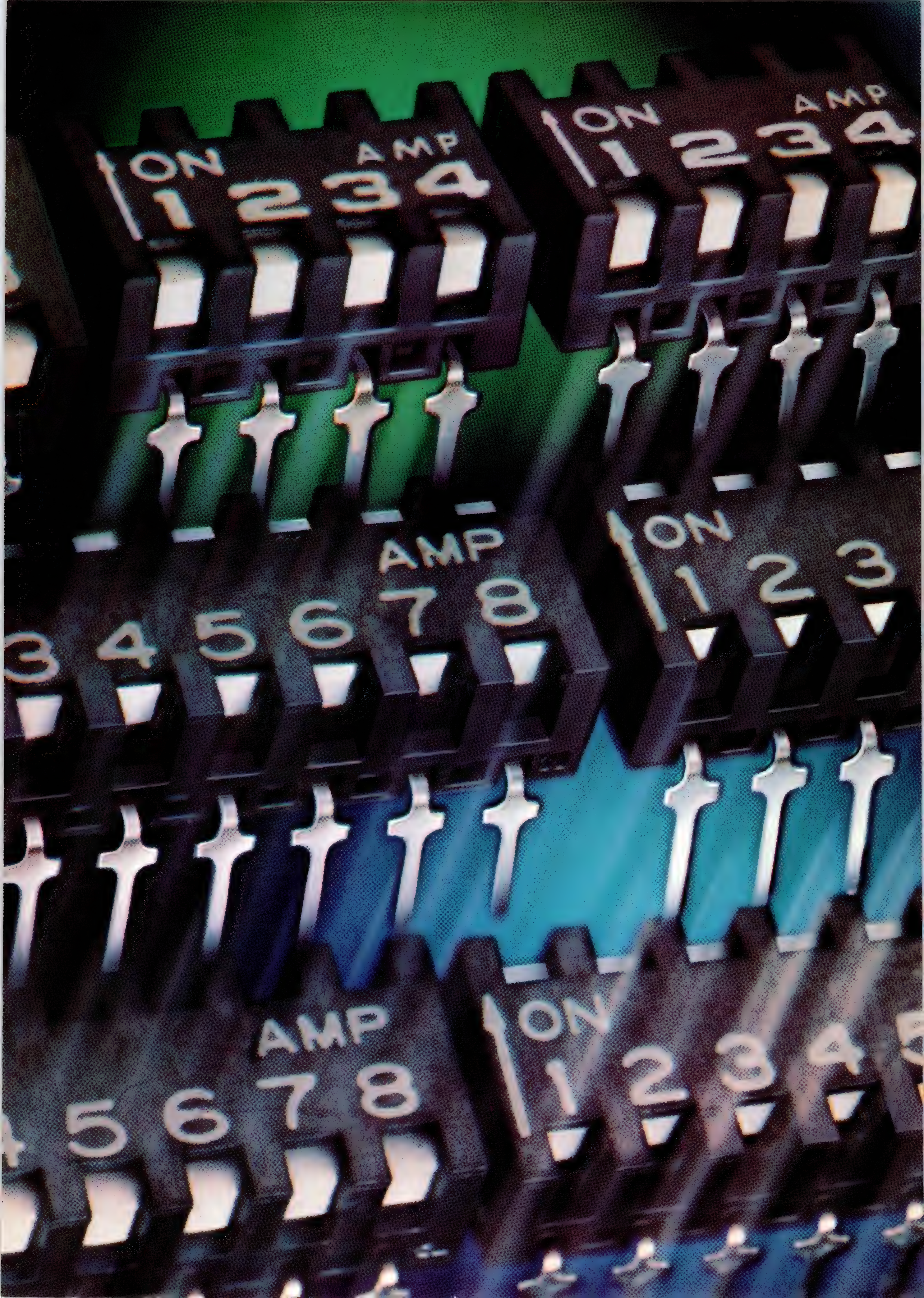
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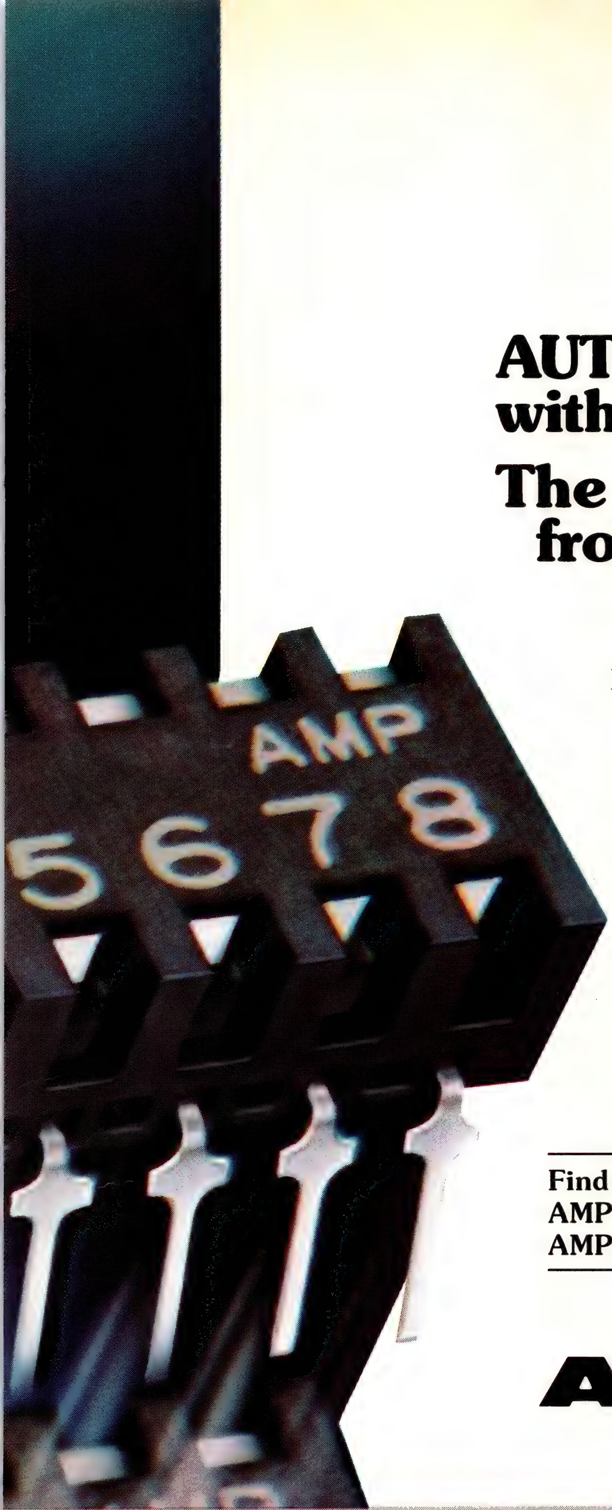

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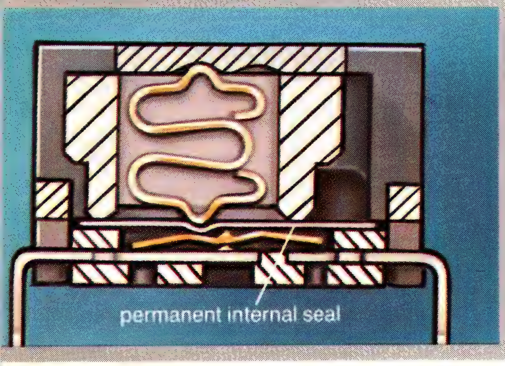

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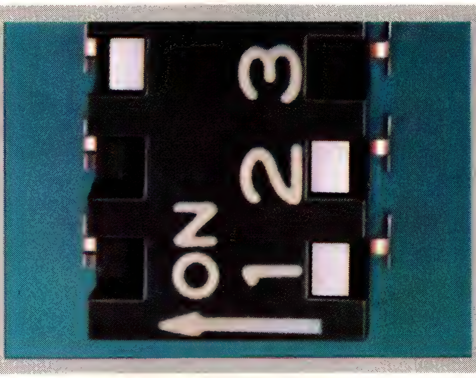

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Bar size:	29,000 mil^2	21,000 mil^2	15,000 mil^2
Speed:	10k samples/sec.	14k samples/sec.	67k samples/sec.
Error:	±0.75 LSB	±0.75 LSB	±0.5 LSB
Inputs:	8 analog	8 analog	11 analog*

*Includes six multipurpose inputs.

Major speed improvements, more inputs, smaller size—the evolution to LinCMOS products from metal-gate technology reflects big performance boosts and operational advantages, creating a bright linear future.

Up to 71,000 samples per second

Dramatic speeds are available—as fast as 71,000 samples per second. With power requirements as low as 6.0 mW.

This allows noise canceling and precise control of blower motors or heating elements. While virtually eliminating bulky power supplies.

Exceptional stability over a wide temperature range

Both the TLC532A family and the TLC540 family offer excellent temperature-range stability—total output error is within ±0.5 least significant bit (LSB) over a wide temperature range—from −40° to 85°C.

Military versions, also available, are stable within ±0.5 LSB over a −55° to 125°C temperature range.

Handle up to 11 inputs

Each LinCMOS A-D peripheral family allows a processor to monitor up to 11 analog signals. Six signals can be digital, if preferred, allowing keyboard or switch-position sensing.

These devices feature a built-in sample-and-hold circuit (software-controlled on the TLC540) that holds a "snapshot" of the input signals to reduce the effects of noise and random spikes.

Immediate availability

All of these LinCMOS A-D peripherals are TTL, MOS, and CMOS compatible. And all are available now. With performance that will change the way you look at linear.

Environmental control is only one possibility. These LinCMOS peripherals offer many opportunities in test equipment, automotive instrumentation, industrial controls, robotics, toys, home computers, signal processing, and other applications.

For more information on TI's a/d converters, op amps, and the LinCMOS process that creates them, call your authorized TI distributor or nearest TI sales office. Or write Texas Instruments Incorporated, Dept. SLA043EC, P.O. Box 809066, Dallas, Texas 75240.

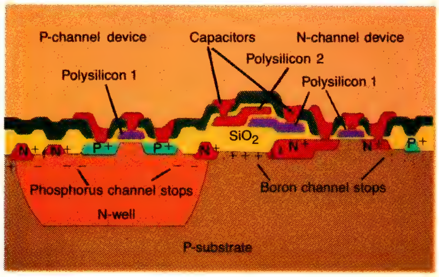
TI is first with silicon-gate CMOS for linear.

The key to a successful combination of CMOS and bipolar capabilities: Phosphorus doping of the silicon gates that effectively halts and binds sodium ions—the main cause of threshold voltage shifts in MOS-based technologies.

For enhanced carrier mobility, NMOS transistors are placed in a p-type substrate and the PMOS transistors in an n-well. This increases carrier mobility of the NMOS transistors to about 3.7 times that of the PMOS transistors, enhancing speed.

The LinCMOS process also provides a gate-to-drain capacitance about one-seventh that of metal-gate CMOS. This performance stems from gate formation, which is accomplished in the same step that forms the transistor source and drain. The source, gate, and drain are all self-aligned, boosting speed and enhancing the bandwidth even further.

And the final result: A built-in speed advantage that greatly enhances AC performance and makes possible the 20X speed improvement of the TLC532A over its pin-compatible metal-gate TL532 predecessor.



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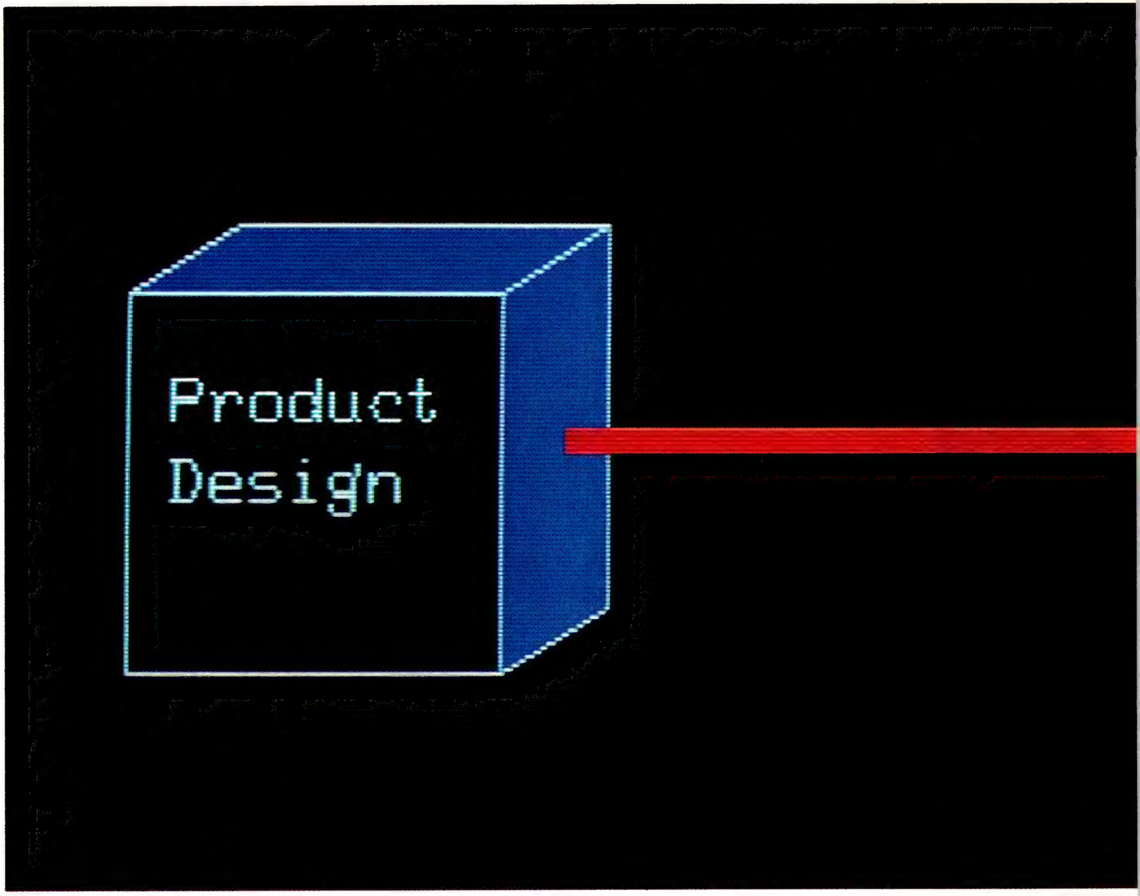


Teradyne presents LASAR™ Version 6. Simulation software created to help manufacturers speed products to market.

Now there's a tool that will really save you time when time is money. Here's how.

How LASAR saves design time.

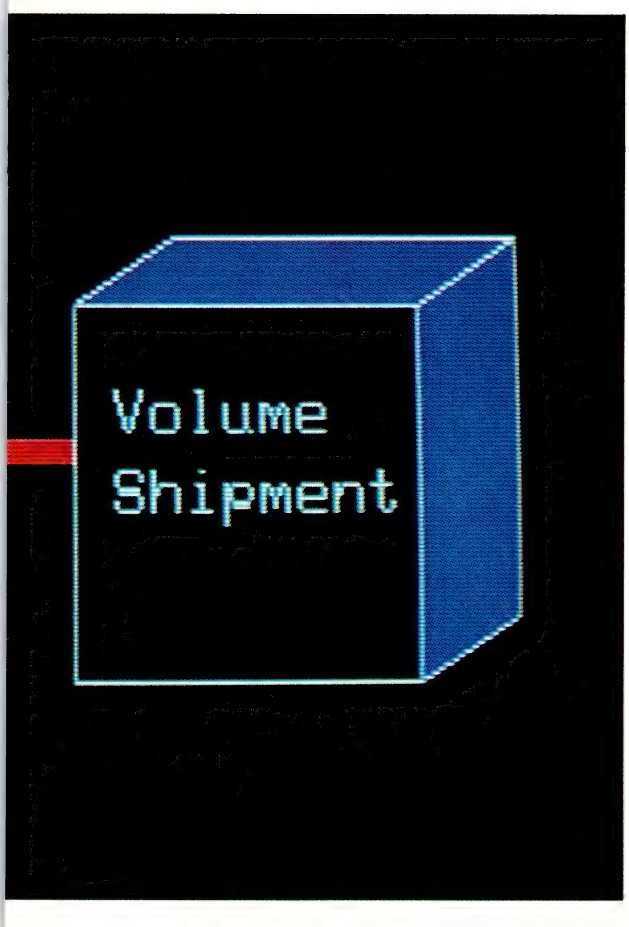
Use LASAR simulation software for design verification and get it right the first time.

LASAR software offers extremely accurate time-based logic simulation. The only worst-case timing analysis that really works. Boolean, functional, memory and MOS primitives together with signal strengths that let you accurately model devices. And a huge library of commercial device models.

You'll avoid spending a lot of time creating multiple prototype iterations. And you'll have all the speed and capacity you need to simulate activity of even the most complex

	Devices	Boards
Design	✓	✓
Test	✓	✓

Using the same software to design and test devices and boards saves you time.



designs—devices and boards. You can save even more time by using one simulation tool for both.

How LASAR saves test development time.

Today more people use LASAR for test program generation than any other simulator.

Using the same simulator for design and test, you can typically save months of development time. There's no need to remodel devices, recreate the net list or rewrite patterns. With LASAR software, design engineers can transfer a proven data base directly to test engineers.

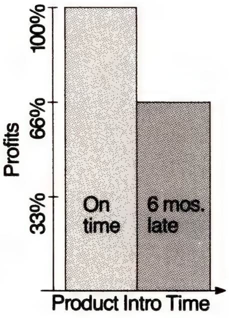
Use LASAR software to improve product testability. Quickly measure the quality of your test program through concurrent fault simulation. And transfer programs created with LASAR software directly to test equipment for fast test start-up.

In other words, with LASAR you will never design products that can't be tested. Or develop test patterns or diagnostics that won't work on ordinary ATE.

Why you should act now.

According to some industry analysts, failure to deliver products on schedule could cost you as much as a third in lifecycle profits.

Using the same tool for design verification and test program generation will help you get products out on time. So the time to act is now. LASAR Version 6 is a tool that will help you get tomorrow's products to market today.



Getting to market on schedule can increase profits by 33% over the life of your product.

For more information write Teradyne, 321 Harrison Avenue, Boston, MA 02118. Or call Daryl Layzer, LASAR Software Product Group, 617-482-2700, ext. 2808.

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The NSF is going to get an EE as its director

Sometimes the decision-making process has a happy outcome, even in Washington. Consider one example: President Reagan has declared his intention of nominating Erich Bloch, a technologist trained in electronics engineering, as director of the National Science Foundation. The announcement happens to come at just the moment when the foundation is deciding whether to throw its weight behind the mushrooming movement to establish industry-supported research and development projects at U. S. universities.

The naming of Bloch, vice president for technical-personnel development at IBM Corp. since 1981, is a significant victory for the engineering community. He will be the first NSF director to come to the foundation from a career in industry—and he will be arriving at a place that has traditionally tilted so sharply toward the "pure" sciences that it often seems to be deliberately avoiding any association with the toiling wretches in engineering and technology. But lately the foundation has been a bit more disposed to get involved with applications; hence, its willingness to consider supporting research links between industry and academia.

Erich Bloch would appear to be the right man at the right time. Trained as an electrical engineer at the Federal Polytechnic Institute in Zurich and the University of Buffalo, his range is wide. In the words of George A. Keyworth II, President Reagan's science adviser, Bloch's "long experience at IBM includes direction of R&D and large manufacturing programs and responsibility for the technical excellence of the personnel of one of the world's most technologically advanced companies. Those achievements are directly relevant to major issues that the foundation is addressing today."

We add our hearty concurrence and hope that, under Bloch, the NSF will enter a new era—one reconciling scientific inquiry with technological and commercial necessity.

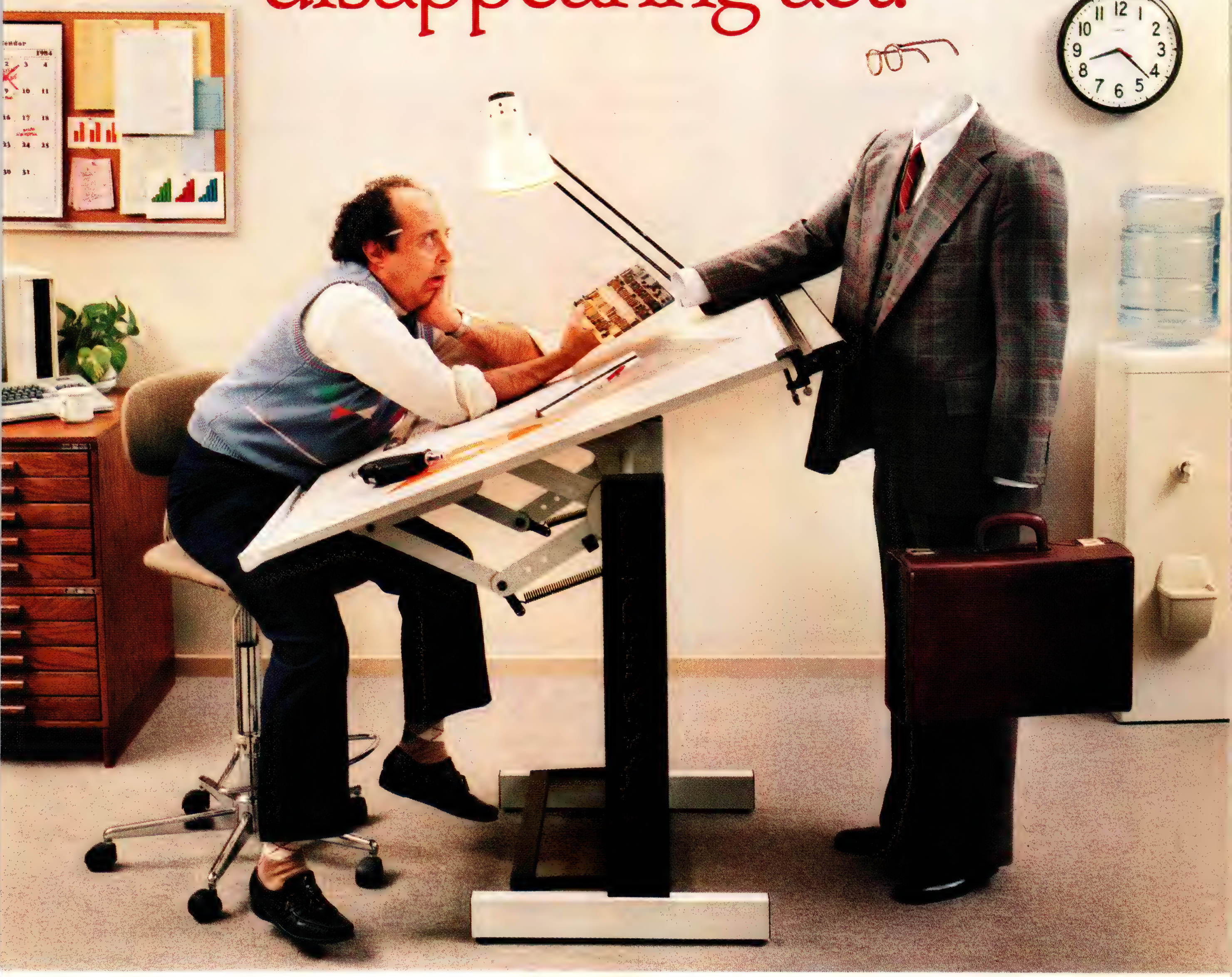
The auto industry's siren call to electronics suppliers

For suppliers who want to do business with the auto makers, the car of the future may seem to present unlimited opportunities. Speaking to the American Electronics Association the other day, R. M. Sinclair, Chrysler Corp.'s vice president for engineering, presented a fascinating wish list.

"Every moving part will be under the control of computers," he told the trade group. For example, engines won't idle; they will simply shut down, pause, then start up again with a touch of the accelerator. Everyone knows that antiskid brake systems are coming, but what about a suspension system with electronic controls that constantly monitor the road surface and adjust the shock absorbers? Or an electronic transaxle that eliminates many hydraulic functions, headlights that compensate for uneven roads, tires that inflate for smooth roads and deflate for mud or sand, and raindrop sensors to start the windshield wipers? Then too there could be voice controls to open the trunk when your arms are full, a programmed seat that automatically returns to your favorite position after someone else has used the car, a mirror that adjusts automatically, and a radio that tunes itself to the station you prefer at any time of day.

The requirements for would-be suppliers are modest. All they must have is equipment that works under the most execrable conditions—under the hood—and with little or no care; absolute, drop-dead, on-time delivery; and prices pared to the competitive bone. Detroit awaits you with open arms.

We won't do a disappearing act.



Naturally every controller company talks about the quality, the reliability and the performance of its products. But few pay enough attention to an equally important issue: Responsiveness to the customer.

Fact is, just getting the kind of service you need can be a a tricky proposition these days. And, unfortunately, if you're not one of the industry's largest customers, you'll probably see that service disappear when you need it the most.

That's why we designed our Responsive 1 program. It's more than just a slogan. It's a whole new act we've built to give you the best products *and* the best service. More rapidly than ever before.

Responsive People

Headlining our new act is a cast of highly qualified marketing and technical professionals. People who'll give you the most responsive support in the industry.

In supporting roles, we've staged a worldwide product distribution network with reps and distributors who get involved with what you're doing. And who know what they're doing.

Responsive Products

For an encore, we've spotlighted engineering excellence. The kind that's introduced almost two dozen new controller products over the last five years.

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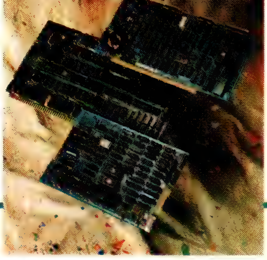

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Meetings

Chinatech '84, Society of Manufacturing Engineers (SME, Public Relations Dept., 1 SME Drive, P.O. Box 930, Dearborn, Mich. 48121), Shanghai Exhibition Center, Shanghai, People's Republic of China, Aug. 28-Sept. 3.

First Convention of the Institution of Diagnostic Engineers, IDE (3 Wycliffe St., Leicester LE1 5LR, England), City Conference Centre, London, UK, Sept. 4–7.

Electronic Displays 84, Network Events Ltd. (Network Events Ltd., Printers Mews, Market Hill, Buckingham, MK181JX, UK), Frankfurt, West Germany, Sept. 5–7.

Byte Computer Show, Byte Magazine (Interface Group Inc., 300 First Ave., Needham, Mass. 02194), San Francisco Civic Center/Brooks Hall, San Francisco, Sept. 6–9.

OEM Design Show, Penton/IPC Publishing Co. (Bill Little, Penton Exposition Division, 122 East 42nd St., Suite 900, New York, N. Y. 10168), Philadelphia Civic Center, Philadelphia, Sept. 9–11.

17th Electronics & Aerospace Conference, IEEE (Susan Vekich, Honeywell Inc., Aerospace & Defense, Honeywell Plaza, Minneapolis, Minn. 55408), Shoreham Dunfey Hotel, Washington, D. C., Sept. 10–12.

10th Advanced Control Conference, Control Engineering (Theodore J. Williams, Director, Purdue Laboratory for Applied Industrial Control, Purdue University, W. Lafayette, Ind. 47907), Fowler Hall, Stewart Center, Purdue University, W. Lafayette, Sept. 10–13.

Third Conference on Stress Screening, Environmental Sciences Institute (ESSEC Technical Program Committee, Environmental Sciences Institute, 940 East Northwest Hwy., Mount Prospect, Ill. 60056), Marriott Hotel, Philadelphia, Sept. 10–13.

14th European Microwave Conference, The Société Belge des Ingenieurs de Télécommunications et d'Electronique *et al.* (Microwave Exhibitions & Publishers Ltd., Convex House, 43 Dudley Rd., Tunbridge Wells, Kent, TN1 1LE, UK), Palais des Congres, Liege, Belgium, Sept. 10–13.

Midcon/84 & Mini/Micro Midwest-84, IEEE (Electronic Conventions Inc., 8110 Airport Blvd., Los Angeles, Calif. 90045), Dallas Convention Center, Dallas, Sept. 11–13.

Electronic Imaging 84, Morgan-Grampian Expositions Group (Electronic Imaging 84, Morgan-Grampian Expositions Group, 2 Park Ave., New York, N. Y. 10016-5667), Westin Hotel, Copley Place, Boston, Sept. 11–13.

Voice Input/Output Systems Applications Conference, American Voice I/O Society (L. Lerman, Avios, P. O. Box 60940, Palo Alto, Calif. 94306), Marriott Crystal Gateway Hotel, Arlington, Va., Sept. 11–13.

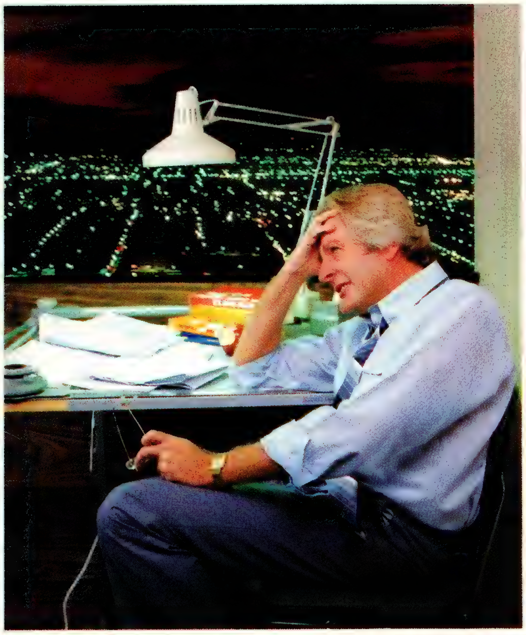
1984 World Congress on Human Aspects of Automation, Society of Manufacturing Engineers (Van Doren, Society of Manufacturing Engineers, 1 SME Drive, Box 930, Dearborn, Mich. 48121), Hotel du Parc, Montreal, Canada, Sept. 16–19.

Compcon Fall 84, IEEE (Joe Batz, Small Computer Revolution, P. O. Box 639, Silver Spring, Md. 20901), Hyatt Regency Crystal City, Arlington, Va., Sept. 16–20.

Eighth International Fiber Optic Communication & Local Area Networks Exposition, Information Gatekeepers (Michael A. O'Bryant, Vice President, Sales & Marketing, Information Gatekeepers Inc., 138 Brighton Ave., Suite 212, Boston, Mass. 02134), MGM Grand Hotel, Las Vegas, Sept. 17–21.

Semicon/East 84, Semiconductor Equipment & Materials Institute (Mary Beth Kern, SEMI, 625 Ellis St., Suite 212, Mountain View, Calif. 94043), Bayside Expo Hall, Boston, Sept. 18–20.

A TALE of TWO CITIES



Sunnyvale, California — 8:30 PM

Boca Raton, Florida — 5:00 PM

How FutureNet's DASH-1™ Has Revolutionized Schematic Design and Documentation!

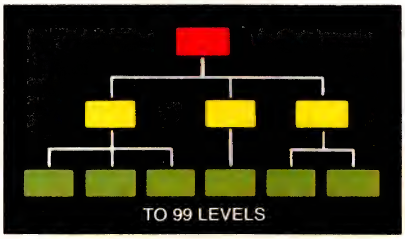
Increased Schematic Design Efficiency

Obviously the engineer in Boca Raton has a big edge over his counterpart in Sunnyvale. The reason is simple. He uses FutureNet's DASH-1 Schematic Designer to create perfect schematics on his IBM PC… in a fraction of the time it takes others who still struggle with manual methods.

Besides producing top-quality schematics, the DASH-1 can automatically generate Net Lists, Lists of Materials, Design Check Reports and other critical support documents. All in all, DASH-1 increases your efficiency as a designer about five-fold… forget those long, wearisome hours slaving over routine documentation.

Extensive Parts Library Included

At the heart of the amazing DASH-1 is a comprehensive symbol library (easily expandable, of course). It includes hundreds of TTL, microprocessor, memory/support chips, as well as discrete components, all with pinouts and pin functions. Call symbols instantly to your screen, move and connect them effortlessly to create your desired schematic while your DASH-1 automatically captures all the intelligence of your design. An optional plotter even allows you to produce a finished pen and ink drawing in minutes. Should you need it, the DASH-1 has full compatibility with most large CAD systems, as well.



Now… Another Stride Forward!

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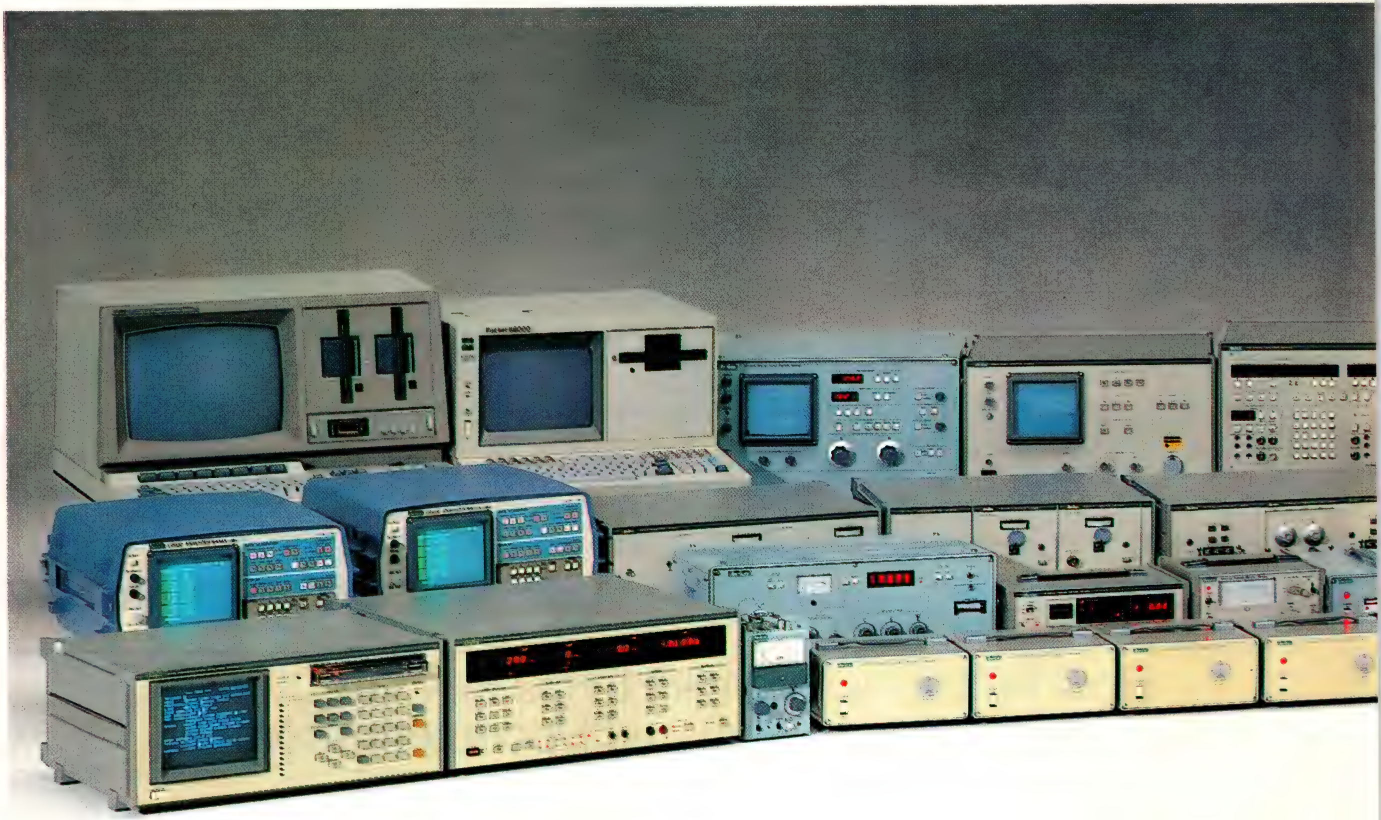

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Anritsu builds the electronic instruments that keep electronic and fiber optic communications operating at the knife edge of efficiency. From the simple measurement of voltage and current to complete high-level analysis of both analog and digital circuitry, Anritsu instruments are built by experts in communications. And Anritsu instruments are built to be used.

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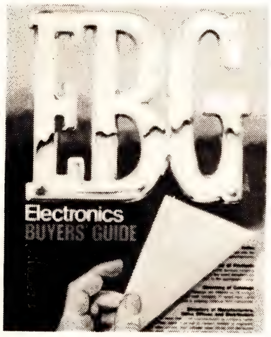

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News update

■ "We have had a lot of victories in the last few years, but this isn't one of them." That was the reaction of Kenneth Hagerty, vice president of the American Electronics Association, upon learning that Senate and House conferees had voted against an extension of the 25% research and development tax credit scheduled to expire in 1985. "Basically, the credit became a bargaining chip," explains Hagerty. The Senate agreed to drop it from the 1985 tax bill in exchange for similar concessions by the House on other revenue-losing items, he reports.

But Hagerty believes the war isn't lost yet. The action on Capitol Hill was not a vote against the credit but rather in favor of a deficit-reduction plan. "We think we'll have a pretty decent shot at an extension after the elections," he says.

If Hagerty and his fellow lobbyists lose that battle, predicts the AEA, present levels of corporate spending on R&D won't be the only casualties. College and university efforts to update and improve their equipment and laboratories through company donations will also be severely hampered, since the measure covered funds for that, too.

The fight to extend or make permanent the R&D tax credit is backed by an impressive array of trade associations representing firms engaged in electronics and other areas of high technology. Besides the AEA, there are the Electronic Industries Association, the Semiconductor Industry Association, the Computer and Business Equipment Manufacturers Association, and the Scientific Apparatus Makers Association. The coalition even put together a report called "High Technology Tax Policies of the 1980s" [*Electronics,* Jan. 26, p. 24].

Meanwhile, the 1985 tax bill isn't all bad news for the electronics industries. Legislators did pass the Foreign Sales Corporation Act, which exempts 17% of combined taxable income attributable to exports. They also agreed to continue to suspend regulations allocating R&D expenses incurred in the U. S. to foreign income. **–Karen Berney**

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BY ANY MEASURE

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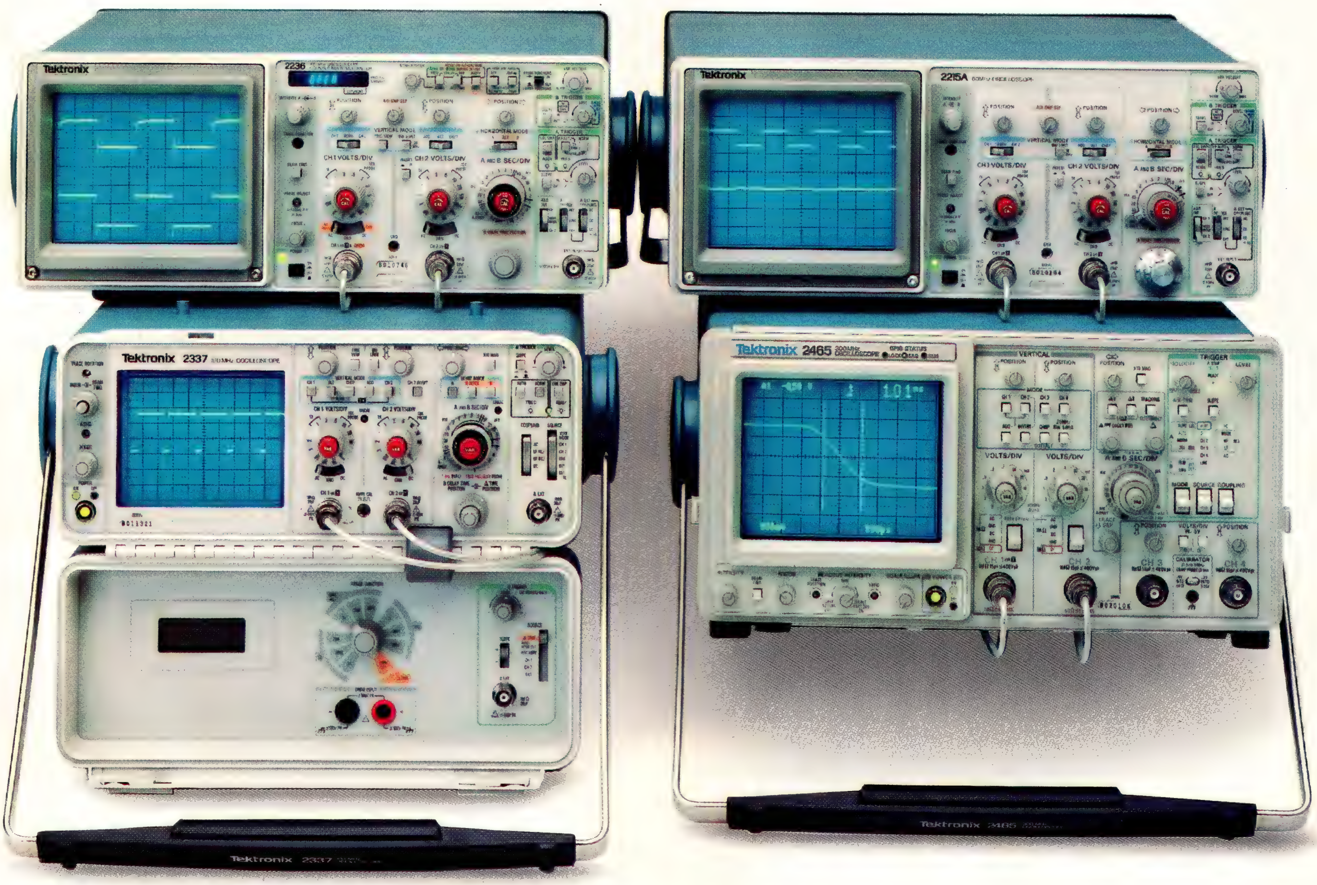

A world standard in performance plus value: the Tek 2000 family of portable scopes. Each one has different characteristics but they have plenty in common: quality that's unmistakably Tektronix. In our 30 years of oscilloscope leadership, no other scopes have recorded such immediate popular appeal.

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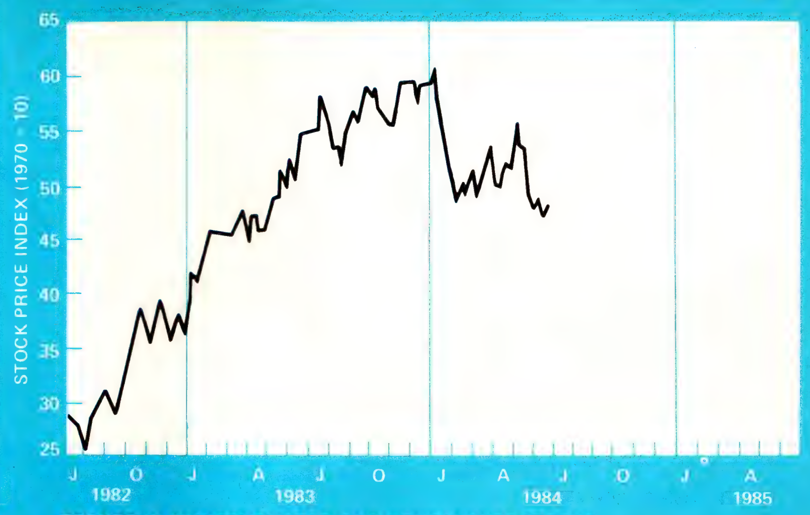
Business activity

"Trends in instrumentation stocks" records the stock market activity of a selected group of publicly owned manufacturers of test, measurement, and analytical instrumentation. The index weights the companies by size and therefore reflects their relative performances.



TRENDS IN SEMICONDUCTOR AND COMPONENTS STOCKS

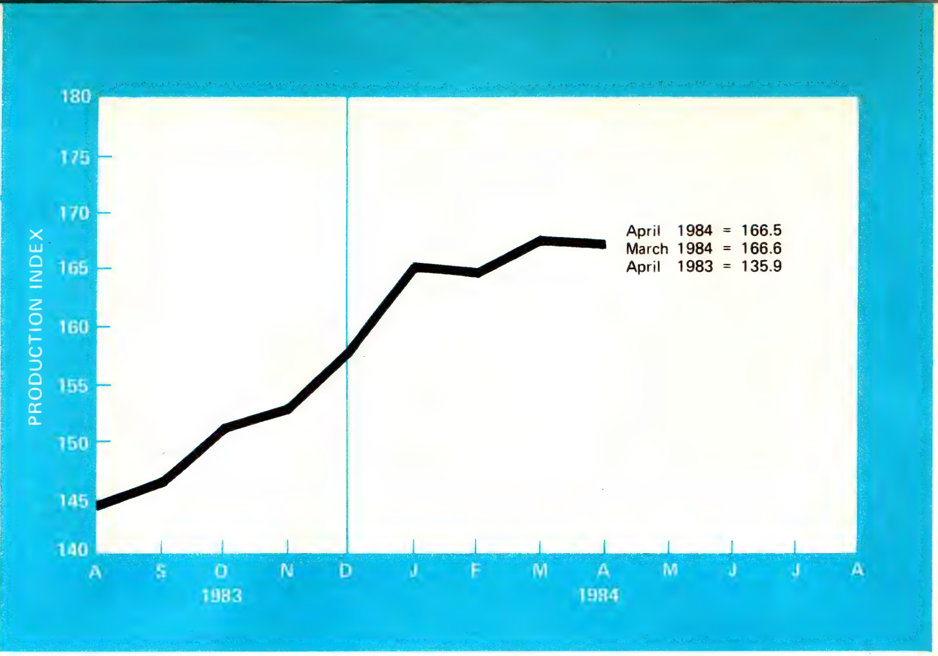
SOURCE: STANDARD & POOR'S CORP

"As the U. S. consumer goes, so goes the U. S. economy" is a maxim followed by many economists. The country's emergence from the recession of 1980-82 was led by consumer spending, as these economists thought it would be, so the household is being watched keenly to ascertain future economic directions. The University of Michigan's Survey Research Center keeps tabs on consumer feeling, and its latest survey shows the U. S. consumer is very confident. Its Index of Consumer Sentiment stands at 99.5, the highest level recorded since the reading of 100 in first quarter of 1966. "The first-quarter-1984 reading was 8 index points above the plateau of 91.5 recorded in the second through fourth quarters of 1983, and 24.2 index points above the year-earlier reading," the center notes. In analyzing the results of its survey, the center found widespread optimism and confidence, and it predicts that the first-quarter survey "points toward continued growth in consumer sales during 1984." More consumers reported better business conditions than in the past 30 years, it adds. "Although consumers expected the rate of improvement to slow, good times financially in the economy as a whole were expected to persist during the next year or so." As a result, the center's report points out, U. S. consumers indicate they have a greater willingness to make major purchases in the next 12 months.

Company financings . . . A third round of venture-capital financing brought $10.6 million in additional capital to *Domain Technology,* a Milpitas, Calif., manufacturer of thin-film recording media. . . . *Zitel Corp.*, San Jose, Calif., which develops and makes microcomputer systems and markets them to original-equipment manufacturers, obtained a $6 million line of credit from *Union Bank of San Jose*. . . . *Xyvision Inc.* completed a $6 million third round of venture financing. The Woburn, Mass., company manufactures computer systems for electronic publishing. . . . A second round of financing garnered *Applix Inc.* $4.5 million in additional funding. The year-old Southboro, Mass., software company is developing a multiuser, distributed desktop office software system based on Bell Laboratories' Unix operating system. . . . *Higher Order Software Inc.,* Cambridge, Mass., raised $5.7 million in a third-round financing. The firm is working on an automated system-development tool. . . . Local-area-network technology vendor *Excelan Inc.,* San Jose, Calif., obtained $2 million from a second-round venture financing, $1.5 million in a line of credit, and $1 million in a fixed capital agreement. –**Robert J. Kozma**

Business activity

The *Electronics* production index is a seasonally adjusted measure of the level of production activity among U. S. manufacturers of office and data-processing equipment, communications and radio-television equipment, instruments, and components. As a reference point, the 1977 yearly average = 100.



U. S. INDUSTRIAL-PRODUCTION INDEX[1]

	April 1984	March 1984	April 1983
Office and data-processing equipment	305.0	312.6	255.9
Communications equipment	203.5	196.9	174.3
Radio and TV equipment	114.8	111.6	80.7
Electronic and electrical instruments	172.9 (May '84)	171.9 (April '84)	156.0 (May '83)
Components	448.6	438.6	331.5

U. S. ELECTRONICS ECONOMIC INDICATORS

Production workers[2] (thousands)	April 1984	March 1984	April 1983
Office and computing machines	200.1	199.1	189.2
Communications equipment	277.1	275.6	258.7
Radio and TV receiving equipment	62.1	61.5	58.9
Components	407.9	402.1	326.8

Shipments[3] ($ billions)	April 1984	March 1984	April 1983
Communications equipment	4.325	4.667	3.899
Radio and TV receiving equipment	0.830	0.893	0.728
Electronic and electrical instruments	4.702	4.590	3.976
Components	3.578	3.634	2.671

U. S. GENERAL ECONOMIC INDICATORS

	April 1984	March 1984	April 1983
Index of leading economic indicators[4]	167.8	166.9	152.5
Budgeted outlays of the Federal government[5] ($ billions)	68.687	73.020	69.542
Budgeted outlays of the Department of Defense[5] ($ billions)	18.711	19.516	19.038
Operating rate of all industries[6] (% capacity)	80.3 (May '84)	80.2 (April '84)	72.7 (May '83)
Industrial-production index[1]	163.2 (May '84)	162.5 (April '84)	144.4 (May '83)
Total housing starts[3] (annual rate in thousands)	1,782 (May '84)	1,990 (April '84)	1,779 (May '83)

Sources:

[1] Federal Reserve Board (1967 = 100) [2] Bureau of Labor Statistics [3] Bureau of the Census [4] Department of Commerce (1967 = 100)
[5] Department of the Treasury [6] McGraw-Hill Publications Co., Department of Economics

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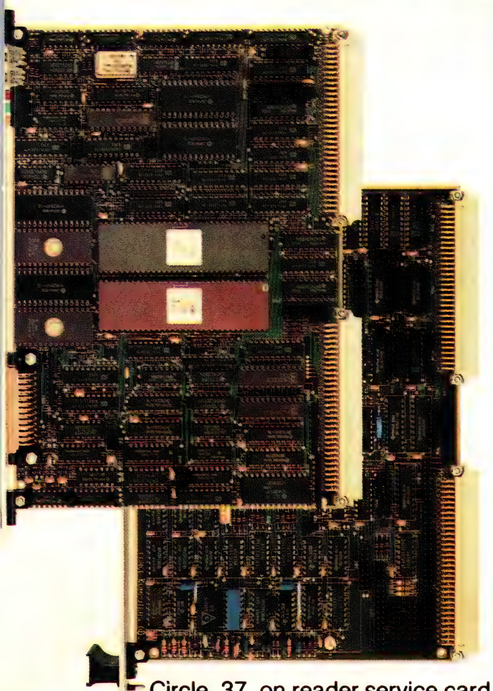

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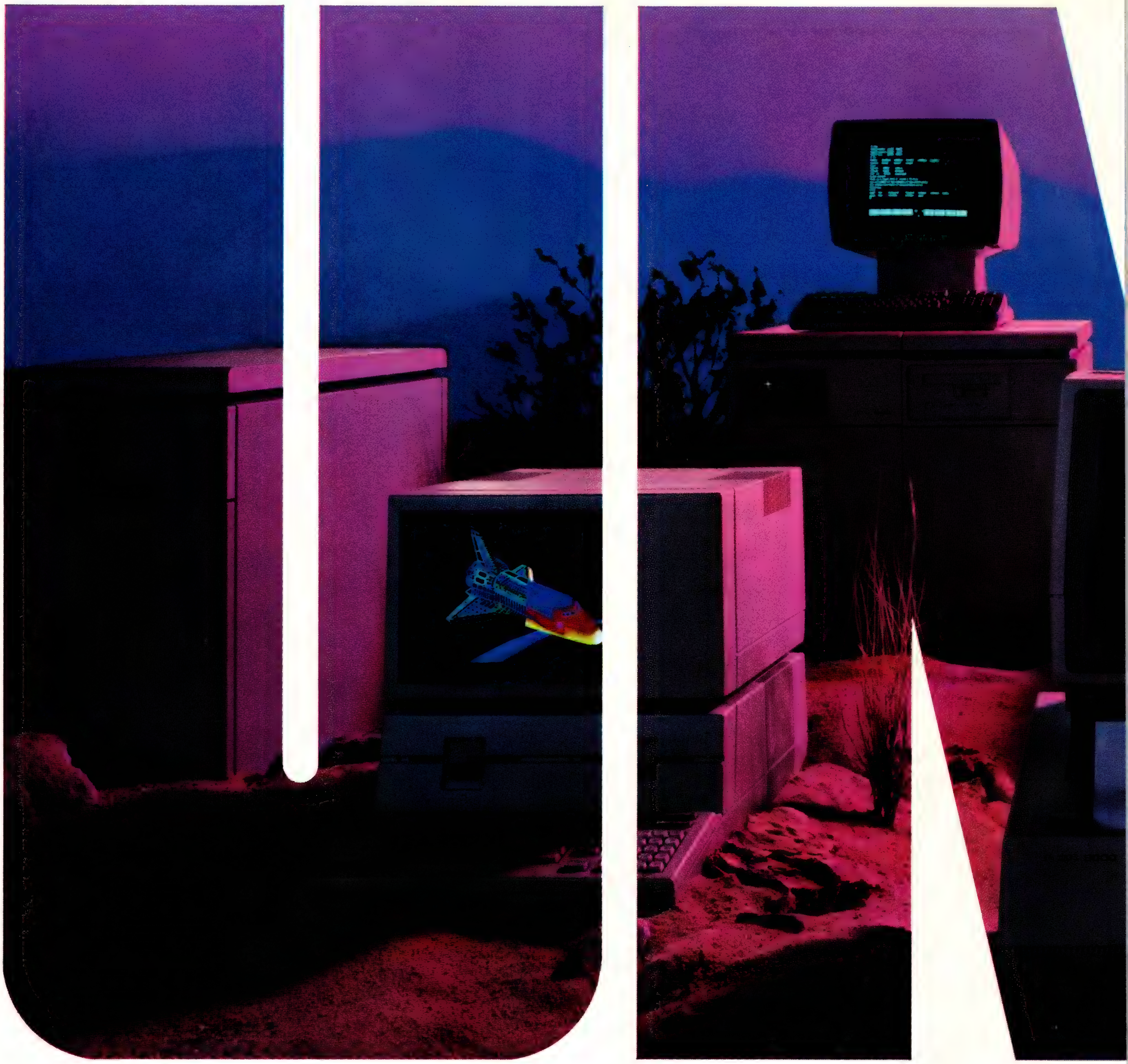

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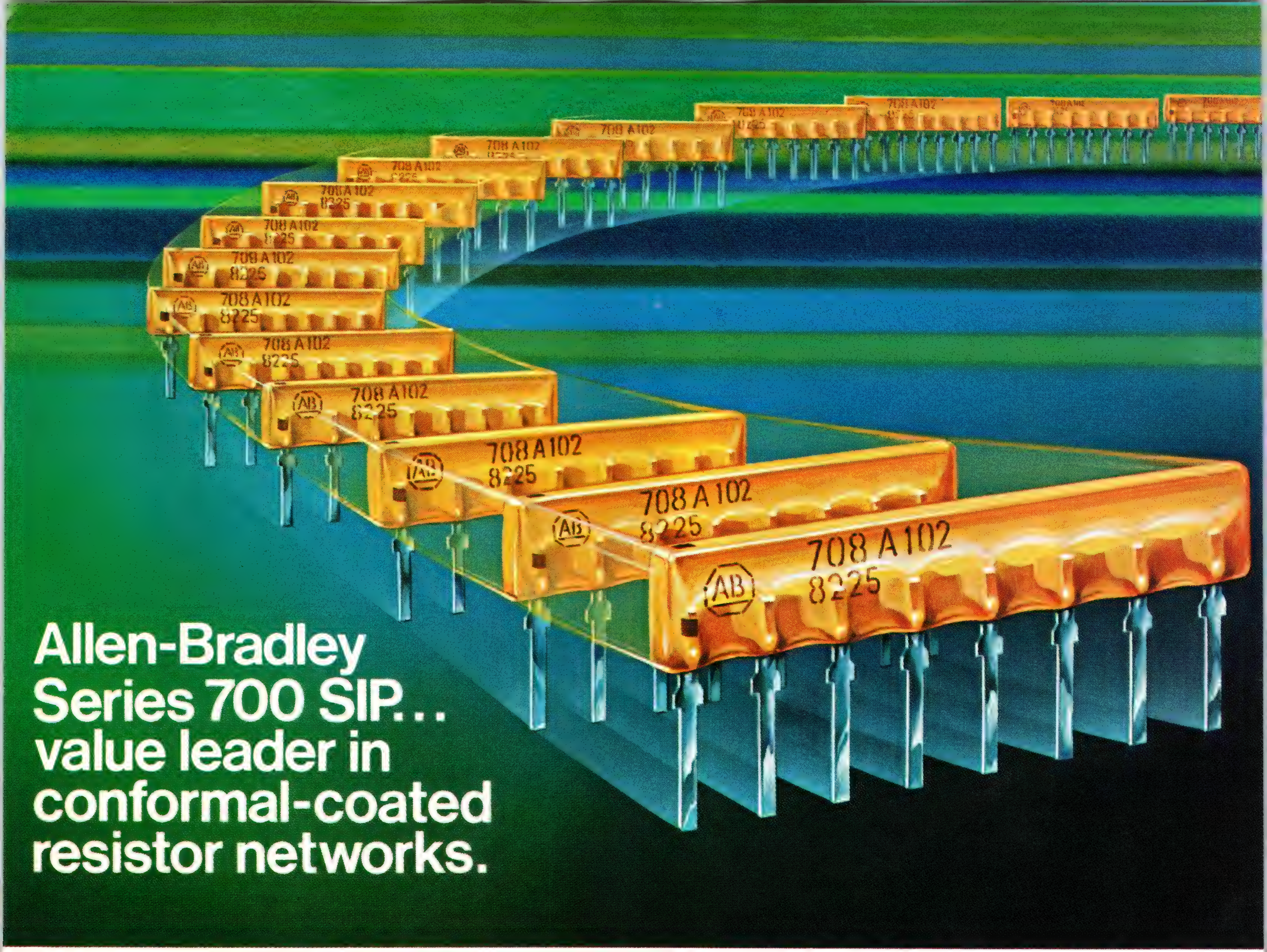

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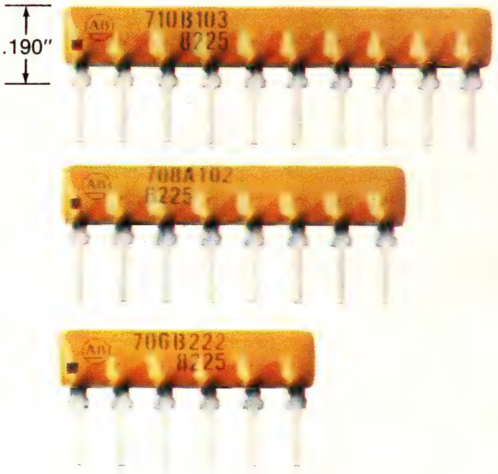

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Electronics newsletter

Single system combines video-disk player and audio compact-disk unit

Hoping to boost sales in video-disk players and audio compact disks and players, at the end of this year Japan's **Pioneer Electronics Corp. will market a video-disk system that doubles as a compact-disk unit**. That development has been eagerly awaited by the industry, which has lately seen a string of retrenchments by several of its major participants (see p. 92). Pioneer for its part hopes that an increase in demand for compact disks will spur record manufacturers to release more titles—which, in turn, would induce more consumers to buy the players. Pioneer says that its new players will have a twofold appeal: they will cost less than separate units do and reduce living-room clutter.

Kaypro assembles a $1,895 package for small businesses

The latest price-cutting ploy to spur lagging sales of desktop computers comes from Kaypro Corp., Solana Beach, Calif., which for $1,895 is offering a single bundled package that will take care of virtually all business tasks for small firms. Kaypro says that it wants to take the confusion out of buying such equipment at low prices. **The Business Pak includes a Kaypro 2X computer with nearly 800-K of storage,** a letter-quality printer, cables, word-processing and spreadsheet software, a data base, operating systems, programming languages, and games. It also introduces a program that operates the hardware as though it were a conventional typewriter and has an electronic-memory typewriter mode. The package will be sold through dealers, says Kaypro.

Logic-array series sports high density

The first product in Applied Micro Circuits Corp.'s Q3500 high-speed logic-array family will have one of the highest densities in this semicustom business—up to 3,500 equivalent gates, according to the San Diego firm. The first array, the Q35005, has typical gate delays of 0.5 ns with power consumption at 3.5 W, or 1 mW/equivalent gate. **A major feature is speed/power programmability at the macro level,** which further lowers gate delays to 275 ps and power consumption to 0.7 mW/gate. In August, the company will be taking first designs, and deliveries are scheduled several weeks later.

Cincom gives Mantis a broader base

At this week's National Computer Conference, Cincom Systems Inc. is expected to push further into microcomputer-level software and also to broaden the base for Mantis, its fourth-generation application-development language, offered as a higher-level alternative to Cobol. Among the products set for introduction at the Las Vegas show is CS/Xtend, **a data-base-management system designed to run on a variety of microcomputers under AT&T Bell Laboratories' Unix operating system**. It follows the release earlier this year of the Cincinnati company's first microcomputer offering, which allows Mantis users to transfer data between IBM Corp. Personal Computers and IBM 370-architecture mainframes. Also new at the show will be an extended release of Mantis, designed to provide increased functionality in IBM 3270 environments, and a new version, VS Mantis, that will run on the VS line of equipment from Wang Laboratories Inc., Lowell, Mass. The new Mantis offerings include a capacity for up to 2,048 variables or elements per program—up from 256 in past versions. The increase will permit the development of significantly larger programs using the language, the firm says.

Name loses distinction, Data Systems Design changes to Qualogy

Finding its name, or part of it, appropriated by too many other electronics manufacturers, Data Systems Design has adopted a new one: as of Aug. 1, the San Jose, Calif., maker of small disk-storage systems will be known as Qualogy Inc. The company will use both the old and the new names during a six-month changeover period. "So many companies have used 'data,' 'systems,' or 'design' in their corporate or division titles that Data Systems Design has become almost a generic name," says company president Richard Preston, echoing a common problem in his industry. The new name is an amalgam of "quality" and "technology." **The firm also announced a new high-capacity storage system** that is compatible with the Digital Equipment Corp. Digital Storage Architecture intelligent interface for Q-bus computers. To be introduced this week in Las Vegas at the National Computer Conference, the Cyclone system includes a 120-megabyte Winchester disk made by Maxtor Inc. and a 20-megabyte start-stop tape backup. (A 110-megabyte system using streaming tape backup was announced by Emulex at the spring Comdex.) Data Systems Design says that at $12,295, its unit offers the lowest cost per megabyte for DEC's proprietary DSA interface.

Computer maker adds standard system

Two manufacturers of computers compatible with IBM's Personal Computer got a boost when Alpha Micro, the Irvine, Calif., manufacturer of small multiuser business computers, unveiled its AM-500 intelligent work station. The first shipments (in July) of the PC XT look-alike being developed by OSM Computer Corp., in Mountain View, Calif., will run MS-DOS and also emulate an Alpha Micro terminal using Alpha Micro's proprietary AMOS operating system. Follow-ons manufactured by South Korea's Goldstar Co. will be beefed up with a stand-alone version of AMOS. **By the end of the year, Alpha Micro plans to have a full-blown version of AT&T Bell Laboratories' Unix Operating System 5** with the Berkeley enhancements across the entire product line.

Computers lead list as electronics business climbs 19% for quarter

The U. S. electronics industries did $39 billion worth of business in the first quarter of 1984, a gain of more than 19% over the same period last year, reports the Electronic Industries Association. Sales of computer equipment accounted for 39.4% of the total; communications gear, for 28.2%; components, for 23%; and consumer goods, for 9.4%. At 29.3% and 27.7%, respectively, manufacturers of electronic components and consumer products scored the greatest sales increases. **Employment figures show that the labor force of the electronics industries climbed by 8.9%, to 1.76 million** workers, for the quarter. The components sector grew at the fastest rate; its work force expanded by 17.2% during the 12-month period from March 1983 to March 1984.

Addenda

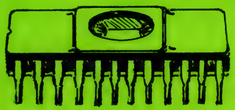
Finally giving up on its efforts to rebuild the troubled division, **Warner Communications Inc. has sold most of Atari to a new company headed by Jack Tramiel,** former chief executive of Commodore International Ltd. . . . At this week's National Computer Conference, **NEC Information Systems, of Boxborough, Mass., will introduce a line of 32-bit minicomputers** that the company says will be in the same class as DEC's VAX machines, Data General's MV series, and the Prime 2250.

ails . . . MC68000 Validated May 21 . . . Others Expected Soon . . . Call for details . . . MC68000 Val

TeleSoft-Ada at Work: Westinghouse packages aimed at airborne radar, VHSIC signal processing.

Westinghouse software engineers reached a milestone when they demonstrated a true distributed processing system programmed entirely with TeleSoft-Ada tools. Four MC68000 processors, each with a unique local operating system, used a parallel processing technique to pass text and data messages, and handle real-time graphics display at four times the speed of a single processor. The programs were designed around existing algorithms for an airborne radar.

Westinghouse is also writing processing algorithms in Ada for its VHSIC 1750A processor, aimed at eventual signal processing applications. Math algorithms already completed include matrix operations for real and complex numbers, such as simultaneous equations, Eigenvector solutions and Eigenvalue solutions. These packages and others have come to the attention of DoD initiatives which may result in a rich body of Ada scientific subroutine packages being placed in the public domain.



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IBM eyes niche in burgeoning supercomputer market

by *Karen Berney, Washington bureau*

Parallel-processing project uses three 4000 series computers and 10 array processors to almost match Cray 1S speed

Is IBM Corp. planning to go into the supercomputer business? True to its standard operating procedure, the computer giant isn't saying yes and it isn't saying no. Nevertheless, experts concluded that IBM was up to something after it unveiled an off-the-shelf design for parallel processing before a gathering of supercomputer users at the end of June.

The configuration that is causing the speculation "amounts to the simple and obvious evolution of standard equipment," maintains Enrico Clementi, the IBM Fellow who conceived the $1.5 million project in order to solve a dynamic problem in molecular chemistry. The project does follow a trend: connecting array processors and computers to form relatively powerful and inexpensive supercomputing systems [*Electronics,* June 28, p. 93].

Now operating in Kingston, N. Y., the IBM hardware includes 10 FPS-164 64-bit array processors from Floating Point Systems Inc., of Beaverton, Ore. Each is equipped with 4 megabytes of storage and is attached to IBM hosts through 3-megabyte-per-second channels. Seven of the array processors are hooked to an IBM 4381 for computational work and the remaining three to an IBM 4341 for program development. A second 4341, connected to a graphics station, completes the system.

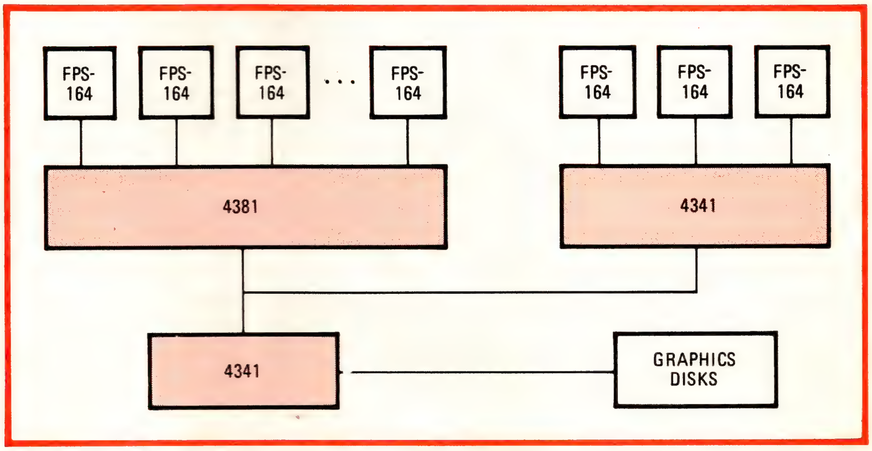
Clementi says that the machine performs so well—nearly matching the execution times of the Cray 1S, even without major software modifications—that IBM has decided to expose it to peer evaluation. This summer, a visiting scientists' program will be initiated at Kingston. Researchers will be brought to the facility to test the possibility of adapting the system to other scientific applications "as well as to teach me how to improve it," says Clementi.

Part of that effort calls for the addition of two new 164/MAX boards per processor by November to boost performance from its current 60 million floating-point operations/s to to 550 megaflops. Further out, 15 of the boards will be added to each array processor, for a maximum capacity of about 3,410 megaflops.

Although IBM executives decline to discuss the company's future business strategy for the Clementi design, observers expect the intensifying supercomputer competition between Japan and the U. S. to galvanize the firm into action.

David Dodson, a senior mathematician with Boeing Computer Services Co., of Tukwila, Wash., observes that "if IBM wants to hang onto the market, it's going to have to face up to Japan now. What better way to do it than with commercially available, reliable hardware that can be assembled in six months and achieve supercomputing speeds for a third the going rate?" That case would appear to be stronger now that Japanese supercomputers are about to break into the U. S. market. Fujitsu Ltd. and Amdahl Corp., of Sunnyvale, Calif., are close to an agreement for Amdahl to sell Fujitsu's supercomputers in the U. S.

Just right. Meanwhile, IBM executives admit that the Clementi solution is exactly what the company and Floating Point Systems have been searching for ever since they signed a joint marketing agreement, three years ago. "Frankly, we see a great deal of potential in the FPS-IBM parallel architecture, but all we are committed to now is determining the



Number cruncher. IBM's parallel processor has 10 FPS-164 64-bit array processors, seven for computational work and three for program development, linked to three 4000 computers.

range of scientific-engineering problems which can be ported to it," says Hilton U. Brown III, a marketing specialist with IBM's Palo Alto, Calif., operation.

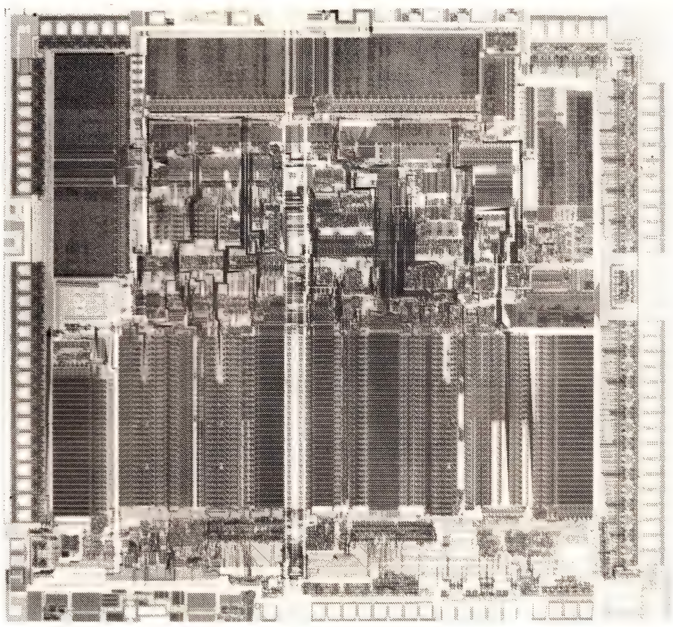
Some ask whether the FPS-IBM union is really an alternative for users who are contemplating the prospect of footing the bill for a Cray, a Cyber, or a Japanese numbers cruncher. Kenneth G. Wilson, Nobel laureate from Cornell University, thinks so. He is working on a project similar to IBM's, entailing eight FPS-100 array processors linked by a custom-built 24-megabyte bus from Aptec Corp., Portland, Ore.; a VAX/11750 is the system's front end. Cornell's contribution is the development of software that will let the network run on AT&T Bell Laboratories' Unix operating system. Within two years, Wilson hopes to expand the system into a goliath housing 4,000 164/MAX boards operating at a whopping 40 billion floating-point operations/s.

Route needed. What Clementi's system lacks is the bus and the accompanying software to permit high-speed data transfer between processors, notes Wilson. But that doesn't mean that IBM and FPS aren't considering developing both, despite the cost. Nor does it imply that they can't sell what they now have. "There are going to be a lot of problems structurally suited to Clementi's parallel solution, and many others that are not," he predicts. Regardless, both firms are bound to let supercomputer buyers know what they can offer. And both are sure to play up the reluctance of users to switch to a new vendor after years of IBM experience, he adds.

Solid state

Motorola takes high-speed, low-power road to 32-bit microprocessor market with 68020

The key to taking the lead in the embryonic 32-bit microprocessor business is combining speed with low power dissipation. That is the message from Motorola Inc., judging from its much-talked-about 68020 32-bit microprocessor, which is also building on the success of the 68000 in 16-bit markets. But to achieve those higher performance standards, the Microprocessor division, in Austin, Texas, last year decided to delay the introduction of the 68020 by half a year, until the end of last month.



Ultrafast. Motorola's 68020 32-bit microprocessor will someday run as fast as 25 megahertz, says the company.

The result is now on display. More die area was designed in high-performance complementary-MOS technology, and an extra million instructions per second were achieved at less than half the original power target. The result, say officials, is a 32-bit microprocessor that will one day run as fast as 25 megahertz. (For additional information on the 68020, see p. 130.)

Initially, Motorola is offering samples that run at 12.5-MHz and cost $487 each. The 68020 is housed in Motorola's square 114-pin-grid array [*Electronics,* April 7, 1983, p. 52]. Volume production is slated to begin in the second quarter of 1985. A 16.67-MHz version is expected to enter initial production by early 1985, giving 68020 customers 2.5 MIPS—in a sustained run rate—at 1 watt of power. In burst mode, the 68020 is capable of handling 8 MIPS.

For reliability. When first announced, in 1982, the 68020 was to operate at 1.5 MIPS, dissipating 2.5 W. However, concerned about reliability, Motorola revised the design, incorporating more HC-MOS. Areas that change states relatively infrequently stayed in n-channel MOS.

The 68020 can run 68000 code 3.25 times faster than the 16-bit microprocessor can, and four times as fast when the code is recompiled for the 32-bit part. Under software control and using its internal sizing registers, the 375-by-350-mil chip also has the ability to downsize word widths on the fly from 32 to 8 or 16 bits. This allows the 68020 to operate with existing 8- and 16-bit 68000s.

In addition to speed, Motorola says it now has the only "full" 32-bit microprocessor on the market. The 68020 has all 32-bit-wide internal registers and on-chip data and address buses. But Motorola's claim is not going unchallenged in the hotly brewing marketplace.

National Semiconductor Corp., in Sunnyvale, Calif., which has been producing its 32-bit 32032 since October and expects to ship several hundred thousand chip sets in 1985, strongly contests Motorola's claim. Although the 32032 microprocessor has 24-bit address registers, National's chip can be fully loaded with 32 bits of data in a single clock cycle, notes Richard Ma-

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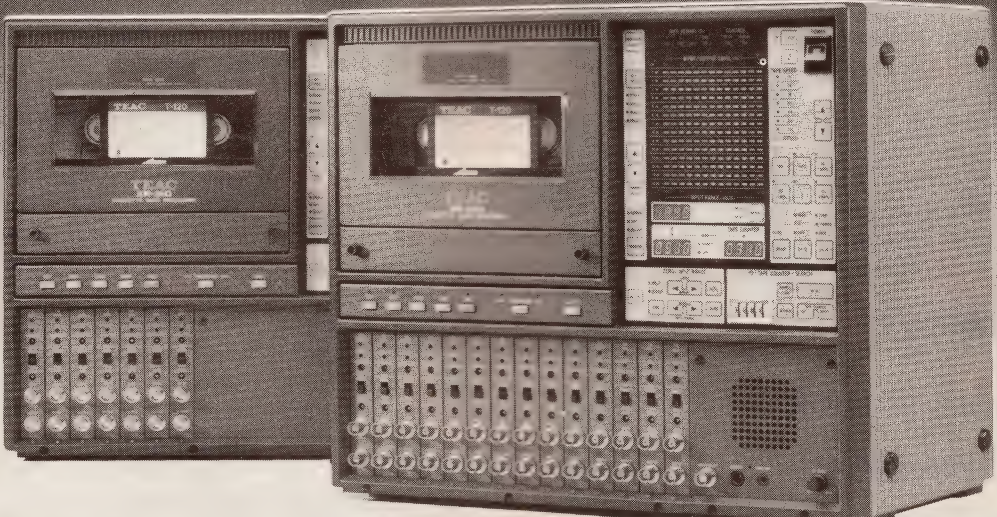

XR-30/50/70

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Circle 160 on reader service card

teosian, technical marketing manager. National opted to design in a 24-bit address register to offer a VAX-like memory-management scheme using two-level tables. All other registers are 32 bits wide. Next year, however, National is expected to introduce a 32332 microprocessor with 32-bit address registers.

Market analyst Edward White, vice president of E. F. Hutton & Co.'s research department, in New York, believes the 68020 will gain attention from its speed and low-power C-MOS design but still says National has the early lead. Also, this spring, Texas Instruments Inc., in Dallas, threw its second-source support behind the family. "There's very aggressive support for National's 32032," White says. "National and TI are bringing out a number of peripherals." Motorola says it is negotiating potential second sources for the 68020. **–J. Robert Lineback**

Military

IR sensors shrunk for target system

The military wants an optical target-acquisition system that works in darkness to augment today's television gear. The trick is to create small infrared sensors with high resolution, but the goal of developing what is almost a new generation of infrared-imaging gear has been an elusive one: for one thing, the sensors must be miniaturized to fit the cramped electronic packages of today's weaponry. Northrop Corp. researchers, however, have recently made important strides fabricating a monolithic array containing 16,384 detector cells laid out in 128-by-128-element grids. Called a focal plane array, or FPA, its charge-injected devices measure 1.2 by 1.2 mil (see "Northrop's focal plane array stares," above).

Along with other military-electronics houses, Northrop has been working on infrared-device technology since 1976, both at its corporate Research and Technology Center and its Electro-Mechanical division, in Anaheim, Calif. "But credit for the FPA should go to semiconductor process improvements that make it possible," says Charles A. Luke, the project's principal systems engineer. His company's investment recently reached $3 million a year.

Instead of silicon, the Northrop devices are fabricated with indium antimonide, primarily because it can be processed at 220°C instead of the 1,350°C that the workhorse semiconductor medium needs. In addition, says Luke, indium antimonide is "a very mature and stable material" whose infrared wavelength, 3 to 5.5 micrometers, makes it good for detecting aircraft. One drawback is the small wafer size, 1.5 inches, which makes room for only 10 focal plane arrays; silicon could handle 10 times as many. Another infrared material, mercury cadmium telluride, permits wafers of only 0.6 in., enough for one focal plane array.

Small and cool. The charge-injection device resembles the more common charge-coupled devices used in solid-state TV cameras but can be made in much smaller dimensions and is sensitive in the infrared rather than in the visible region. Like infrared thermal imaging, the device must be cooled (to 77K) for proper operation.

Although sensors have advanced quite slowly, they still outdistance the microchips available for processing the analog output signals read from the focal plane array. For example, in the trial demonstration of the 128-by-128-element focal plane array, only a single frame of data could be handled at a 170-microsecond dwell-time rate—adequate for showing feasibility but not for actual operation. To get up to speed, Northrop has just taken delivery on a custom complementary-MOS chip that will serve as a frame integrator. The chip will accept the full analog output at 3,840 frames/s, average them, and produce the result at 30 frames/s. This boosts speed to a 22-μs dwell time.

Northrop has put its focal plane array into a prototype system where it works with a TV-based target-acquisition arrangement, and the company expects to have an engineering version by 1986. The 128-by-128-element unit is adequate now, but a focal plane array with 256 by 256 elements has been fabricated with indium antimonide. Luke says a team is investigating the chips' potential as signal-processing units in the Pentagon's Very High Speed Integrated-Circuits program. **–Larry Waller**

Northrop's focal plane array stares

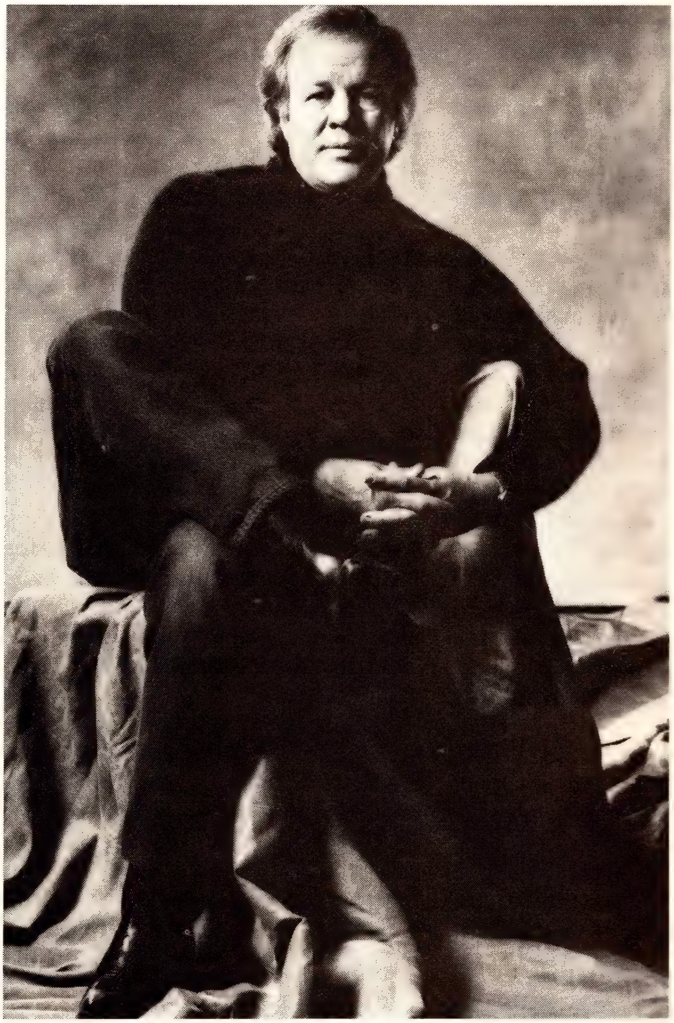
Focal plane arrays come in several flavors. For its version, Northrop Corp. has picked the "staring mode"—which makes smaller parts possible and eliminates moving mirrors and their mechanical complexity—instead of the more common scanning type. Scanners have a higher resolution per detector cell, but staring units compensate by adding a large number of cells, each of which obtains one spatial signal sample. What's more, staring focal plane arrays are directly compatible with standard TV components used in existing optical target-acquisition systems, such as the one Northrop designed for the widely used Hawk ground-to-air missile. When perfected, focal plane arrays could easily be incorporated into present weapon-system electronics. **–L. W.**

Components

Bipolar transistors pick up speed

Designers of power-conversion equipment would like to build fast and efficient circuits with relatively inexpensive bipolar transistors. But doing so hampers efficiency, so bipolar devices have taken a back seat to cascode circuits, power MOS field-effect transistors, and gate turn-off thyristors. To get bipolar devices into the game, Thomson Semiconducteurs in Aix-en-Provence, France, has devel-

"IN 2001, WE REACHED THE STARS. NOW, WE CAN PRACTICALLY TOUCH THEM."



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oped a base-drive method to increase their speed and safe operating area.

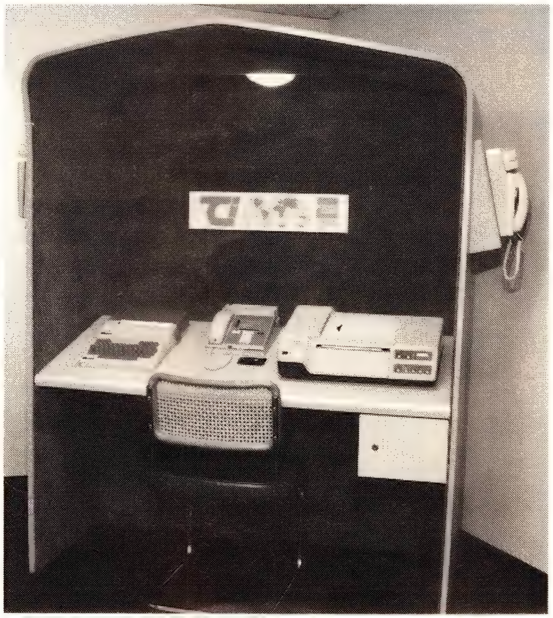
The new drive circuit—called the reversed emitter current drive—was first described at June's Power Electronics Specialist Conference, in Gaithersburg, Md. The part utilizes a MOS transistor to reverse the emitter current of the bipolar transistor, thus substantially cutting turn-off delay times. The result is an ultrafast turn-off switching time for bipolar transistors.

Klaus Rischmuller, who developed this method, has demonstrated that a device that switches 850 volts and 10 amperes is able to turn off in about 400 nanoseconds with a collector current fall time of less than 10 ns. In addition, the drive widens the safe operating area of high-voltage transistors to values close to their V_{CBO} rating. **–Ashok Bindra**

Data communications

Kiosk data service expands nationwide

If Minneapolis start-up Telematic Concepts Inc. has its way, business travelers in major metropolitan markets will soon be using its kiosks in hotels, airports, and major office buildings to communicate not only by voice, with a telephone, but also by document, with teletype and facsimile equipment. Having completed a six-week market test using the booths in three Minneapolis hotels [*Electronics,* April 5, p. 42], the 11-month-old firm is now ready to begin expanding the new service nationwide. "We firmly believe that we're in an age where communication on a real-time basis, not only by voice but by documents, is necessary," declares company president Al Zortea.



Data booth. Telematics Concepts plans booths that offer voice and document communications at hotels and airports

The Telematic Concepts booths will be equipped with computerized Transaction 2 telephones, supplied by AT&T Co., as well as with the 3M EMT 9140 Digital Facsimile Transceiver and the 3M Whisper Writer Teleprinter, supplied by 3M Co. To use the equipment, customers will need only an American Express credit card. Transaction processing and phone-line interface functions will be handled by Tandem NonStop II computers installed in Telematic Concepts' Minneapolis offices and linked to a Northwestern Bell digital switch and American Express computers. All transmissions will be sent over AT&T Long Lines.

In addition to real-time two-way voice and document services—customers will be able to receive as well as to send printed materials at the booths—Telematic Concepts will offer message services using human operators in its Minneapolis offices. Business travelers will be able to avoid telephone tag by leaving verbal messages with an operator for later delivery to the recipient. Teletype or facsimile messages can be sent to equipment at the Minneapolis center, for delivery later. Operators in the center will also be available to help with problems with facsimile or teletype transmissions.

Charges will be based on a 64¢-per-minute flat rate for straight long-distance services. Facsimile and teletype users will be charged an additional $4 flat rate. American Express will handle billing through the customer's regular monthly statement.

With test marketing complete, Telematic Concepts has made aggressive plans for rolling out the service. About 25 booths will be installed in the Minneapolis-St. Paul area this month, with installations in other cities to begin in August, initially at a rate of 50 to 100 booths per month. New York and Chicago will be first, with plans to have booths in Atlanta, Miami, and Dallas before year's end, says Zortea. The firm expects to have 2,400 to 3,000 booths in place by the end of 1985 and figures it will set up 8,000 to 15,000 locations within four to five years.

Some doubts. Industry observers have had mixed reactions to the idea. At Cyrus J. Lawrence Inc., in New York, telecommunications analyst Amy L. Newmark observes that the firm may run into competition from a growing number of "voice mailbox services," which have begun springing up recently. At Salomon Brothers Inc., also in New York, analyst Mark Luftig points out that, within two years, regular business travelers will be carrying portable phones for use with cellular systems, and he is skeptical that demand for facsimile and other document services will be enough to support Telematic Concepts' system.

Zortea, however, says that the very existence of the service will create new markets by encouraging increased use of technologies such as facsimile. The company's projections call for facsimile, teleprinter, and message services to account collectively for about 10 transactions per business day for each booth, while the long-distance service is expected to garner about 20 calls per booth per day. **–Wesley R. Iversen**

Toxic waste

IC makers face contamination suit

Always considered clean and noncontaminating, the semiconductor industry suddenly finds itself the target of lawsuits and investigations as health-endangering compounds come

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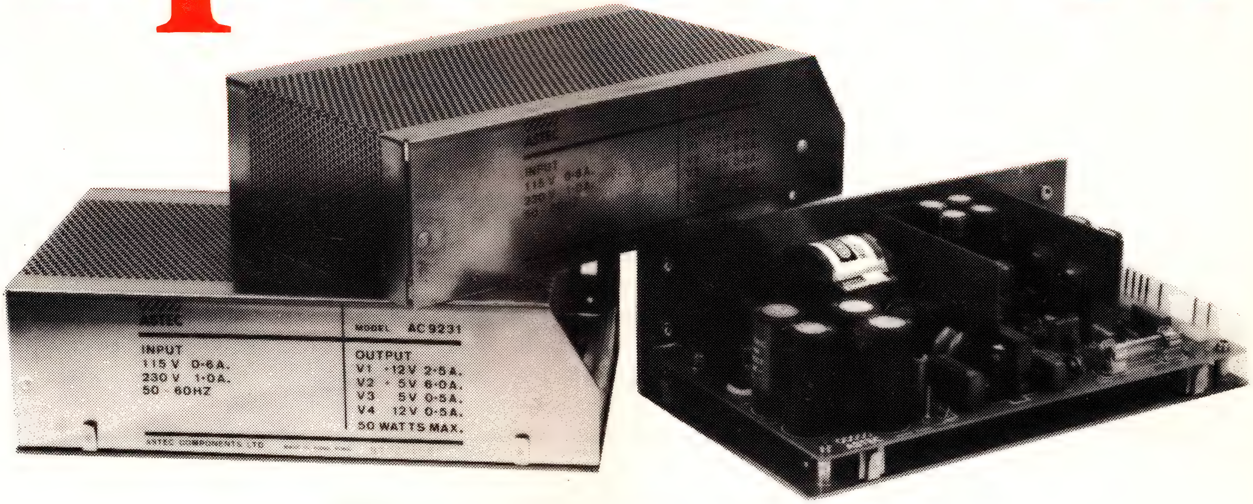

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to light in Silicon Valley soil, ground water, and wells.

Two of the recently discovered compounds, trichloroethylene and trichloroethane, were formerly used as solvents in semiconductor fabrication. Last month's discovery of contamination in many private wells has caused fears about the safety of drinking water and forced investigations. Two families have sued a semiconductor firm, charging personal injuries and property damage.

Trichloroethylene was widely used for flux cleaning and vapor degreasing until the late 1970s, when it was abandoned as too toxic: it has been found to cause cancer in laboratory animals and is believed to be harmful to the human liver and central nervous system. The Environmental Protection Agency says that any level of trichloroethylene may be harmful; Santa Clara County has set 5 parts per billion as the level at which cleanup action must be taken. In some wells, contamination ranges from 200 to 2,800 parts per billion.

Storage tanks used by several Silicon Valley firms—among them the object of the suit, Teledyne Semiconductor Corp.—are suspected of causing the leaks, but since the compounds were buried several years ago, clear responsibility is hard to pinpoint. Teledyne has offered to subsidize the cost of connecting affected residents to Mountain View city water and to pay for bottled water in the interim. Other firms with tanks are Signetics Corp., Advanced Micro Devices Inc., and TRW Inc.

A citizens' group called the Silicon Valley Toxics Coalition has been leading the campaign to force companies to clean up the mess. At a recent rally, the group's attorney, Theodore Smith, charged that there has been "massive seeping of chemicals into the ground water and, in some cases, the drinking water." He displayed a map on which he said some 140 leaks were pinpointed.

Dr. James E. Cone, chief of the occupational health clinic of San Francisco State University, told the group not to drink or even wash with water contaminated with trichloroethylene and other chemicals. Cone said that they cause depression, sleepiness, memory loss, and mood swings, and also warned that although they are excreted quickly, no study has ever been made of their long-term effects. Humans can be exposed to the chemicals by drinking, inhaling fumes, and washing with contaminated water.

Signetics says it has spent $3 million in cleanup efforts that included removing 5,000 cubic yards of soil, installing three treatment systems, and drilling 100 exploratory wells. AMD spokesman Andrew Rothman adds, "We've been going ahead with a fix to the problem": an attempt to pump more than 250,000 gallons of water a day through filters and air-stripping towers. Nevertheless, in mid-June, the regional water-control board ordered Signetics, AMD, and TRW to get together and submit a detailed cleanup proposal by July 15. At the site of another leak, in nearby Mountain View, Intel Corp. has been controlling the movement of hazardous chemicals since March 1982.

It is now thought that most of the leaks occurred in the mid- to late 1970s. In April 1982, the regional water-quality board sent questionnaires to 1,400 area companies about their underground tanks. As a result, the board is examining 80 sites in Santa Clara County. Prompting the survey was the discovery in late 1981 of a toxic leak at a Fairchild Camera & Instrument Corp. site in San Jose. The company has since spent $15 million to clean it up. **–Eve Bennett**

News briefs

AMD prepares to market data-compression chip

Later this year, look for Advanced Micro Devices Inc., of Sunnyvale, Calif., to introduce a data-compression chip, the AM7970, for use in facsimile-transmission equipment. Company chairman W. J. Sanders III, who described the chip to a group of financial analysts last month, says that the 7970 can make it possible to transmit an 8½-by-11-in. document in 1 to 2 seconds over an ordinary phone line. He characterizes the part as potentially instrumental in a major change in future office systems.

GM acquires Electronic Data Systems from Perot

Marching with a vengeance into high technology, General Motors Corp. has acquired Electronic Data Systems Corp., the Dallas data-services company founded by H. Ross Perot [*Electronics,* May 31, p. 47]. The $2.55 billion purchase is the largest in the giant auto maker's history and the one least related to its basic business. Perot, who says GM has agreed to keep EDS relatively autonomous, will stay on, leading to speculation among industry watchers about whether GM can live with a company so highly regimented that it bars employees from having beards.

National seeks to prevent Government ban

National Semiconductor Corp., which has admitted that it inadequately tested ICs sold to the Federal government and had to pay $1,750,000 in fines and penalties, will go to court Aug. 2 seeking an injunction to prevent the Pentagon's Defense Logistics Agency from carrying through its threat to shut out National from Government business for three years [*Electronics,* June 14, p. 50]. Current work would be excluded. A plea by the Santa Clara, Calif., company for a temporary ban has been rejected.

Production

Modification process replaces hand wiring

A Massachusetts company has come up with a technique that makes it easier and less expensive to modify printed-circuit boards. Such modifications remain a common necessity,

SCIENCE/SCOPE

In designing and making a satellite part entirely via computer, Hughes Aircraft Company developed what may be a first in computer-aided design/computer-aided manufacturing. The part is a launch lock pivot plate for the Intelsat VI communications satellite. (The plate keeps the inner and outer sections of the spacecraft together until it is time to begin the spun/despun operation in space. This operation stabilizes the satellite in orbit.) The plate was designed on a CADAM system and made on a computerized milling machine driven by a ComputerVision system. Because CADAM lacks the ability to run milling machines without extensive manual manipulation, engineers developed a custom translator. This new programming allowed CADAM data to be understood by ComputerVision and, in turn, by the milling machine. The use of CADAM and ComputerVision in tandem is believed to be an industry first.

Geologists teamed with the U.S. Navy over Mt. St. Helens in 1980 to use the latest defense technology for a unique view of the simmering volcano. Their eye was the nation's first fully integrated night attack system, built by Hughes for the A-6E Intruder aircraft. The system, called the Detecting and Ranging Set (DRS), includes a thermal imaging sensor that sees through darkness, smoke, or haze. Infrared images recently released by the Navy showed significant hot spots two weeks before the May 18 eruption. The imagery prompted civil authorities to step up their warnings and evacuation efforts. The DRS let geologists view the entire mountain or zoom in to examine areas of interest. Videotapes were made on flights for later evaluation. Geologists said the DRS gave them a broader, more precise thermal picture of the volcano than was otherwise possible.

Night will turn into day for helicopter pilots flying low and fast over rough terrain while using a new infrared system. The Helicopter Night Vision System (HNVS) is designed to make it easier for a pilot to fly low-level missions at night, in adverse weather, or in hazy and smoky conditions. The system uses a forward-looking infrared (FLIR) sensor, mounted in a turret under the nose of the helicopter, to project TV-like pictures of the outside world on the pilot's helmet visor. When the pilot glances in any direction, a helmet servo linkage causes the turret to aim automatically along his line of sight. The pilot can have flight symbology superimposed on the helmet, further reducing his need to look down at cockpit displays as he flies. HNVS is produced by Hughes.

Defects in printed circuit boards are spotted quickly and accurately with a color graphic display in one Hughes manufacturing division. Digital information from the computer-aided design of boards is processed before testing begins to create exact images of board topography. Automatic equipment identifies circuit faults and notifies a central computer. If the computer detects a failure trend, it will include an advisory in the test report so defective processes may be investigated. The test data file is then sent to a computer-graphics work station. There the board image is displayed, with each fault area shown in contrasting color. Hit-or-miss troubleshooting is thus eliminated.

Career growth opportunities exist at Hughes Support Systems for a variety of engineers qualified by degree or extensive work experience. They include systems engineers, radar engineers, and software and hardware design engineers for major simulation and test equipment programs. Also, field engineering posts throughout the U.S. offer travel, autonomy, and responsibility for the life cycle of Hughes electronics systems. Please send your resume to Lowell Anderson, Professional Employment, Dept. S3, Hughes Aircraft Company, P.O. Box 9399, Long Beach, CA 90801-0463. Equal opportunity employer. U.S. citizenship required.

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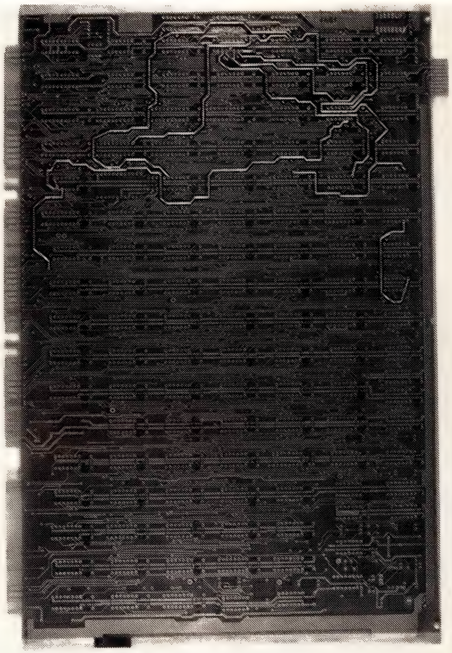
especially for computer boards, even as computer-aided design spreads through the industry. But the usual method—hand wiring and soldering—is laborious, time-consuming, and expensive, and frequently leads to wiring errors.

In the Wire Ink modification process, developed by Additive Technology Corp., of North Chelmsford, wiring changes are deposited onto an added-on insulation layer placed over existing printed wiring. This, says the company, costs 30% to 40% less than hand wiring at no reduction in reliability. In addition, Additive Technology can complete a board with 20 to 50 changes in about two weeks. By comparison, to completely redesign and fabricate a circuit board can take anywhere from six to eight months.



Light work. Wiring changes made by depositing a layer over printed wiring cut costs and time. The modified wiring is seen in the shiny lines in the photo.

The cleanly wired modification is easy to access with a bed-of-nails fixture; a hand-wired board with its spider web of wires is difficult to access. Wire Ink modification is particularly advantageous when a board needs at least 8 to 10 changes, since it is a batch process; hand wiring must be done serially.

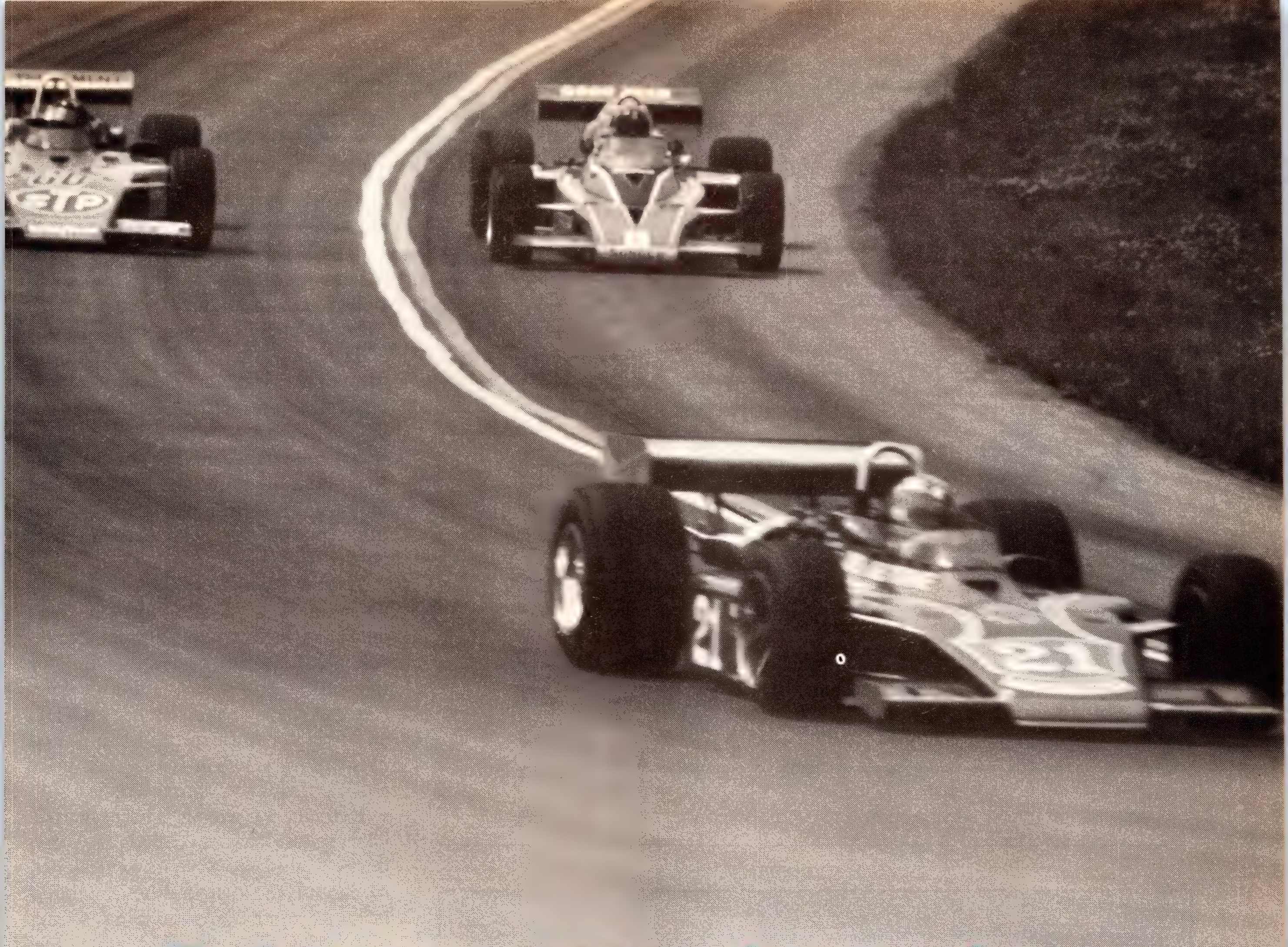
The process starts with severing the conductors. Next, a dry-film resist is laminated to the surface over the existing conductors and exposed, developed, and cured. (Beyond its function in the modification process, the laminated dry-film resist protects the surface of the original board.) Then the pattern of the circuit modification is screened on with a proprietary resin and copper ink; a special coating of copper powder is put over the copper ink, and the combination is cured. After the curing, solder is screen-printed over the copper ink. Then the solder and the copper are fused together in an infrared reflow-soldering machine. Finally, the boards are washed, visually inspected, and tested on a bed-of-nails continuity tester.

Yields of the modification process are running at more than 95%, says Additive Technology. President Raymond DesMarais says his company is now working on boards for Digital Equipment Corp., NCR, Wang, and Sperry. **–Jerry Lyman**

Office automation

AT&T's local net seizes initiative from IBM as giants battle for office-automation market

Generally overlooked late last month when AT&T Co. introduced its first personal computer was perhaps the announcement's most significant aspect: the company stole a march on IBM Corp. in the battle to dominate the office-automation market. Capitalizing on its telecommunications strength, AT&T also introduced its new local network—winning what



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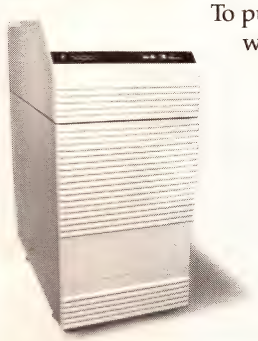

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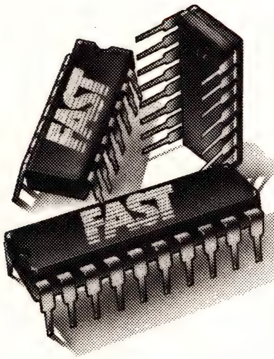

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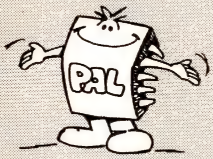

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company watchers believe is a two- to three-year lead over IBM.

"It's a definite plus that they have a network ahead of IBM," says Ulrich Weil, an industry analyst with Morgan Stanley & Co., New York.

The network, called the AT&T Information Systems Network, combines fiber optics and standard twisted-pair copper wire to create a high-speed link between AT&T's new personal computer, the model 6300, and mainframes, terminals, printers, and other peripherals. The network uses packet switching.

"It's a strong product," says W. Spencer Rice, a specialist in local networks at S&R Consultants, Madison, N. J. "With twisted wire for low-end PC-to-PC connection, a gateway to their coaxial-based 3BNET, and fiber for high-speed, it's a nested networking solution with great price and performance characteristics."

Extends the wiring. The network's fiber-optics option, called the Premises Lightwave System, is designed to extend the distribution capability of AT&T's standard building wiring plan. Two fiber interface units, one at the controller end and the other at the terminal end, are linked by a fiber-optic-cable pair. The fiber interface units connect to the terminals through four two-wire lines with balun adapters, which also make it possible to connect the terminals directly to a cluster controller through building wiring.

"The system should be viewed as a terminal concentrator," explains George F. Colony, managing director for Forrester Research Inc., of Cambridge, Mass. Hence, he says, a network best suited to linking terminals to a mainframe computer is not the ideal environment for a personal computer. Nevertheless, Colony believes that the new AT&T machine will appeal to those looking for an alternative.

The Model 6300 sells for $2,745 to $4,985; connection costs for an entry system to the Information Systems Network run $400 to $500 without new wiring. The computer is available through retailers now, and the network will reach the market in January 1985. –**George Leopold**

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Washington newsletter

GAO attacks FAA's modernization plan . . .

Supercomputers and satellite-based radio positioning systems should form the backbone of the nation's next generation of air-traffic-control systems. But unless the Federal Aviation Administration rethinks its 10-year-old modernization strategy, billions of dollars will be spent on technology that will be obsolete and in need of replacement by the mid-1990s, warns the General Accounting Office. **"It's just another example of a Federal agency failing to keep up with the latest technological developments,"** notes Douglas Cannon, a senior systems analyst who helped prepare the GAO's critique. For example, the FAA wants to equip its 20 air-traffic-control centers with new scanning-beam radar systems at a time when users throughout the world are saying that satellites may offer significantly better coverage, accuracy, and capacity at a lower total cost. "It just doesn't make sense to take an interim step when a leap is within our means," concludes Cannon.

. . . and Congress responds with new spending rules

The message hasn't been lost on Capitol Hill. First of all, the House, in its 1985 appropriations bill for the Department of Transportation, says that the FAA must submit a full report answering the GAO's concerns 45 days before any purchase of new hardware. Second, the FAA must prove that the proposed equipment will be able to satisfy its future software needs. Finally, **the lawmakers have cut $20 million from the agency's budget for ground-based radars** and put a freeze on spending until the FAA produces a study on the feasibility of a space-based air-traffic-control system.

FCC okays frequencies for satellite system

In keeping with the order from Congress, the Federal Aviation Administration may be able to come up with the feasibility study as early as 1987. Following a year of intense lobbying by the Geostar Corp., Princeton, N. J., the Federal Communications Commission has decided to allocate frequencies to an operational satellite system for radiolocation services. The firm is the first and, up to now, the only company with both a design and an application pending for approval by the FCC. In all, Geostar wants slightly more than 100 MHz of spectrum in the 1.6-, 2.5-, 5.0-, and 6.4-to-7.0-GHz bands in order to operate what it hopes will at first be the FAA's emergency aircraft-positioning system. **The biggest market, however, lies with private light-aircraft and pleasure-boat owners** who cannot now buy radio-locationing gear because it is too expensive, says Geostar. User units should sell for between $300 and $500, the firm estimates.

Model assesses benefits of more accurate testing

A new management tool developed by the National Bureau of Standards can help companies predict whether the benefits of buying a fancier or more accurate piece of automatic test equipment will justify the cost. **This statistical model tells managers the likelihood that an ATE system will accept a defective product and reject a good one**—probabilities expressed as functions of both systematic and measurement error. Such information can help cut costs stemming from diagnostics and field repair, as well as from retesting and maintaining excessively high inventories, says the bureau. Although limited to analog measurements, the model probably will be widely adopted by industrial and military producers. Besides computing the economic effects of changes in the accuracy of measurements, it can be used to improve maintenance and calibration of existing ATE systems and to determine which test specifications optimize the economic tradeoff between the cost of a system and its level of accuracy.

Postal automation depends on OCRs, says OTA analysis

Optical-character-recognition systems constitute "the only technology choice" for the U. S. Postal Service in its drive to cut costs by as much as $9.4 billion by the year 2000, concludes a new technical analysis from the congressional Office of Technology Assessment. Furthermore, some $500 million to $3.5 billion could be saved right now if **the USPS follows the OTA's advice and converts all of its single-line scanners to multiline OCRs,** which also have the ability to sort and process the nine-digit zip codes that are beginning to be used, says the analysis. It also predicts that as the information age matures, the role of OCRs is bound to diminish, so the USPS will have to compete head on with electronic media. But that confrontation is at least 10 to 15 years away, and the OCR "will be faced with increased opportunities before the electronic ax falls," forecasts the congressional office's analysis.

U. S. leads the world in R&D spending

U. S. investment in research and development far outstrips that of any other Western or Eastern nation, according to the latest international data from the National Science Foundation. In 1981, the U. S. spent $72.1 billion on R&D, compared with $27.1 billion for Japan and $15.8 billion for West Germany. Of that total, about one fifth supports R&D in the electrical and electronics industries; the total for Japan and Western Europe is one fourth. **Surprisingly, Japan spends only 6.7% of its budget on computer R&D,** nearly half the U. S. and West German percentages. In addition, the U. S. scientific and engineering work force, standing at 743,000 in 1983—some 6 out of every 1,000 workers—is greater than the combined total of Japan and Western Europe (West Germany, France, and the UK). On the negative side, however, domestic patent activity has continued to decline. Foreign-originated patents now constitute more than 40% of all U. S. patents, compared with 29% a decade ago, the study indicates.

Addenda

The Federal Communications Commission is still promoting the cause of deregulation: **it has lifted all functional and technical restrictions on the use of carrier signals** by a-m radio-station owners. The move follows the freeing up of fm subcarriers a year ago [*Electronics,* March 22, p. 97]. Previously, a-m carrier signals were limited to remote-control telemetry and utility-load management. . . . **The Commerce Department says it will soon select one of two private bidders to take over the operation of the nation's land remote-sensing satellite system.** The two contenders—Arlington, Va.'s Eosat, a joint venture between Hughes Aircraft Co. and RCA Corp., and a team led by Eastman Kodak Co., Rochester, N. Y.—were among the seven companies that responded to the Government's January request for commercialization proposals [*Electronics,* Dec. 29, 1982, p. 37].

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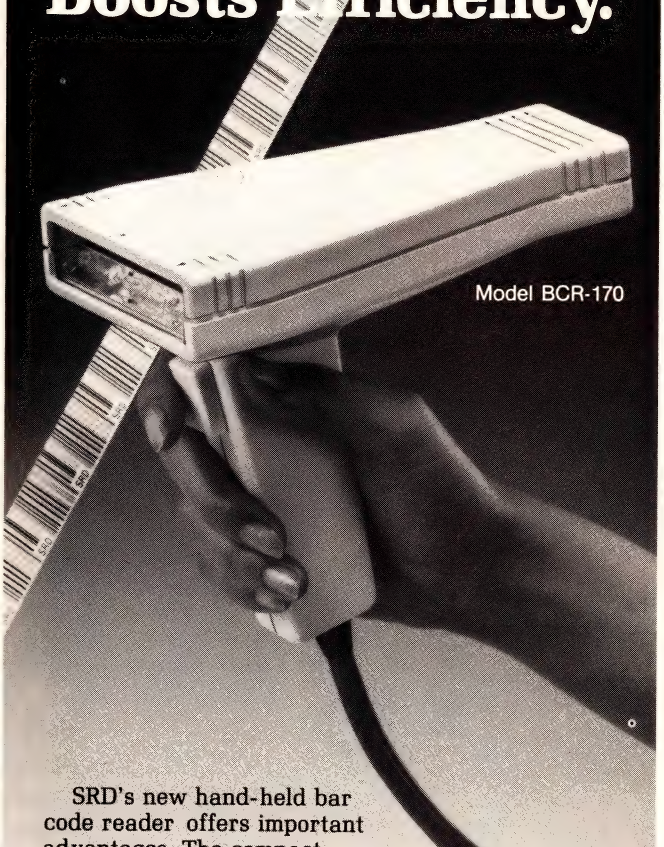

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Circle 62 on reader service card

International newsletter

BBC succeeds with all-digital broadcast chain

In the latest of a series of tests to prepare the way for stereo-TV sound broadcasts in the UK, British Broadcasting Corp. engineers have demonstrated an all-digital broadcast chain: digitally recorded source material, a digital transmission link, and digital stereo sound transmission from the BBC's transmitter at Wenvoe, in South Wales. Digital stereo sound is favored as a UK standard because it can be picked up in difficult reception areas and because it is potentially compatible with the proposed Multiplexed Analog Component (C-MAC) UK standard proposed for direct broadcast by satellite. **Much work remains to be done before the engineers complete a specification, which may be offered as a European standard.** West Germany has already started a stereo sound service using analog techniques, and France is proposing a different DBS standard, better suited to cable transmission.

Sinclair starts R&D on wafer-scale integration

Sinclair Research Ltd. has begun work on wafer-scale integration at its new Metalab Research & Development Center, in Cambridge, England. Heading the project is Malcolm Wilkinson, who developed a working prototype wafer-scale system in 1981 at Burroughs Machines Ltd.'s Research Center in Cumbernauld, Scotland [*Electronics,* Sept. 22, 1981, p. 73]. Though the prototype worked, Burroughs discontinued research. Based on the ideas of computer theoretician Ivor Catt, **these wafer-scale techniques use self-testing, self-connecting logic cells with a novel serial architecture** and provide a form of serial multiprocessing.

IC makes it easier to produce diode-tuned TV tuners

Intermetall GmbH, in Freiburg, West Germany, the lead house of the ITT Semiconductors group, has readied an IC that greatly simplifies the production of diode-tuned TV tuners by eliminating the need for carefully matched tuner diodes and for aligning the tuner circuits for proper tracking. With the UAA2920, **roughly matched tuner diodes with a capacity deviation as high as 10% can be used.** Until now, the diode capacities had to be held within 2%, which made the process of measuring and selecting a group of diodes very time-consuming, while raising the diodes' price. The bipolar 2920 uses Intermetall's proprietary collector-implantation technology, and after a voltage-comparison process, it makes sure that the diodes track properly. The IC will come in an 18-pin plastic package and should be available during the second half of this year.

Brazil Univac unit sold by Sperry

Protectionist government policies that prevent multinational computer manufacturers from producing small machines were a major factor in Sperry Corp.'s decision to sell off its Brazilian Univac computer division to a local company, Mater Engenharia S. A. **The Brazilian company paid $8 million** and will merge Univac with another of its companies, Novadata Sistemas é Computadores.

SGS-Ates profit climb continues under Pistorio

Italian semiconductor producer SGS-Ates Componenti Elettronici SpA, of Agrate, which in 1983 turned a profit for the first time in a decade, continues to impress, with exceptional results for this year's first quarter. Sales hit $76.875 million—an 80% increase over the same period in

1983—net profits reached $3.375 million, and orders jumped by 174%, to $140.375 million. **The company's recovery program was engineered by chief executive officer Pasquale Pistorio, who played the company's strong card—innovative use of high-voltage linear technologies—**in the export market, particularly the U. S. He also shored up the company's weak points with strategic agreements, such as a technology-and-design-exchange accord with Toshiba for MOS circuits. Pistorio left Motorola in 1980 for SGS, with a promise to return the ailing Italian company to profitability within four years. He beat the self-imposed deadline by one year.

Matsushita digital TV has a window

Matsushita Electric Industrial Co. is the first Japanese maker to announce a color TV set using digital circuitry for video signal processing. **The unit, whose audio circuits remain analog, features a 6-in. inset screen,** which monitors VCR, video disk, or camera outputs while the rest of the screen receives TV programs. Matsushita will produce the model at an initial rate of 3,000 sets a month and bring them to market in November. The $1,090 price is some 12% higher than conventional models fetch but lower than digital models from competitors.

NEC GaAs IC has super wideband amplifying power

In August, NEC Corp. will market what it claims is the world's widest-band gallium arsenide integrated circuit for microwave amplification. **The IC is said to be capable of amplifying microwaves from 0.05 to 3 GHz,** compared with the 0.8-to-1.8-GHz capability of a similar part from Siemens AG. NEC's part has applications in satellite and microwave communications systems, cable TV receivers, and measuring instruments. Samples cost $17.

Disk-pack standardization moves electronic cameras closer to market

Electronic still cameras may soon hit the market now that a committee of 32 manufacturers has standardized the magnetic disk pack to be used to record pictures. Pictures can be viewed on home TV (as they can in the Sony prototype announced in 1981), printed on a home printer [*Electronics*, March 10, 1982, p. 71], or printed professionally. The Electronic Still Camera Committee includes manufacturers of electronic equipment, optical cameras, and magnetic tape—27 from Japan, 2 from the U. S., and 3 from Europe. **Standardized disk packs can record 25 pictures if each is a complete TV frame, 50 if each is a single field.** The medium in the 60-by-54-by-3.6-mm disk pack is a 47-mm-diameter floppy.

Renault and UTC in joint venture for auto connector

Nationalized French transportation-equipment giant Régie Renault is about to sign a contract with United Technologies Corp., of Hartford, Conn., to create a joint venture that will use the U. S. company's technology to make a wide range of connectors for use in automotive applications. The new company, to be owned 51% by United Technologies and 49% by the Parisian company, is slated to begin production at Decazeville, in the southwest of France, by the middle of next year. **Renault's objective in the $10 million venture is to lessen its dependence on external suppliers of connectors,** which it thinks will be a strategic area of the future. By 1987, the two companies expect to be selling half of their production on the open market.

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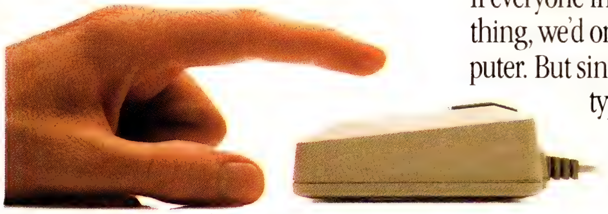

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MASSCOMP chose the Motorola 68000 Family "because of its high performance and 'big machine' capabilities."

The very high performance of the MASSCOMP Work-Station-500 is achieved by distributing the system workload to subsystems supporting graphics, data communications and other complex operations. The CPU features a 10 MHz 68010 plus a 10 MHz 68000.

The MASSCOMP system also uses other 68000 processors for memory management, in its Array Processor, and in its Independent Graphics Processors.

"We chose Motorola because of its commitment to leadership in VLSI technology, and we're pleased Motorola has introduced the next generation of 68000 series devices."

Lorrin Gale, Vice President of Engineering, MASSCOMP

Auragen Systems uses the MC68010 to provide its "customers with leading-edge technology."

"We believe power and price/performance come from utilizing as many processors as possible to solve a customer's problem. In our fault tolerant System 4000, separate 68010s provide executive, user, and communication functions. Our intelligent terminal uses its own 68008.

"Motorola's commitment to the 68000 product line has enabled us to concentrate our development effort on providing our customers with leading edge technology. We have already made the design changes needed to incorporate the 32-bit 68020 chip into the System 4000. No other family of compatible processors and support chips allows us to provide such power and ease of use to our customers."

Samuel D. Glazer, System 4000 Architect, Auragen Systems Corp.

Alcyon chose Motorola because "It was obvious that the MC68000 would make a great UNIX* micro engine.

"The 68000's orthogonal instruction set, large virtual address space and rich addressing modes are particularly well suited to high level language and operating system development . . . The architectural benefits of the 68000, combined with considerable interest shown by third-party software houses in the 68000, made it a natural choice for Alcyon's family of high performance UNIX Operating System workstations. Alcyon's super micro computers achieve their high performance in par through use of MC68000 as both host and I/O processors.

William E. Kehret, Executive Vice President, Alcyon Corporation

Cadmus chose the Motorola 68000 because it's today's performance leader.

"The MC68000 is the heart of our distributed main frame architecture. It's also used to control our bit-map, high resolution graphics display. Cadmus chose the 68000 family of products because the 68000 is today's performance leader in microprocessors and the UNIX* Operating System standard; because the 16MByte address range allows us to run extremely large processes; because the 68000 has become the standard for third-party 32-bit software and the standard microprocessor for running minicomputer applications; and, finally, because 68000 family plans convinced us of leadership through the '80s, and Motorola meets its commitments."

Bill Kiesewetter, Vice President of Marketing
Cadmus Computer Systems

what they all needed.
Family is what they all chose.

CalComp chose the Motorola M68000 Family because its comprehensive built-in diagnostics reduce board count.

"In CalComp's newest line of vector plotters, Models 945, 965, 1073, 1075, and 1077, the M68000 was chosen because it makes the following features economically possible:

"Data Manipulation . . . allowing incoming data to be tailored to the user's needs . . .

"Interactive Control Panel . . . the user is led through setups with English language-like statements and prompts . . .

"Plotter Parameter Control . . . so the user can optimize operation for the given media, pen, and ink.

"Maintainability . . . the comprehensive built-in diagnostics continuously monitor plotter performance and quickly identify the source of any malfunction, reducing the mean time to repair to minutes in almost every instance."

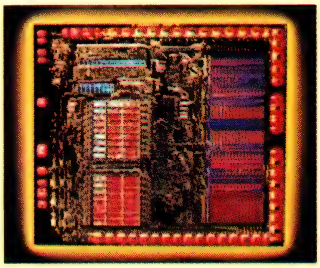
Dave Schlotterbeck, Vice President, Product Development, CalComp

Cadnetix chose the Motorola 68000 for its large linear address space and 32-bit performance.

"Our choice of the Motorola 68000 family for our CDX-5000 system was guided primarily by two requirements. First, the large data structures required for graphics data manipulation necessitated a large linear address space. The 68000 was the only commercially available microprocessor which offered this feature. Second, the ability to handle 32-bit calculations was also necessary."

"High performance cannot be stressed enough in describing our microprocessor needs. The CDX-5000 outperforms all comparably priced products and even compares favorably to superminicomputer products at less than half the cost."

Bruce Holland, President, CADNETIX Corporation



When high performance is what you need, the logical choice is the same one these fast-track companies made — the Motorola M68000 Family. The technology is here today for all the products you'll build for tomorrow.

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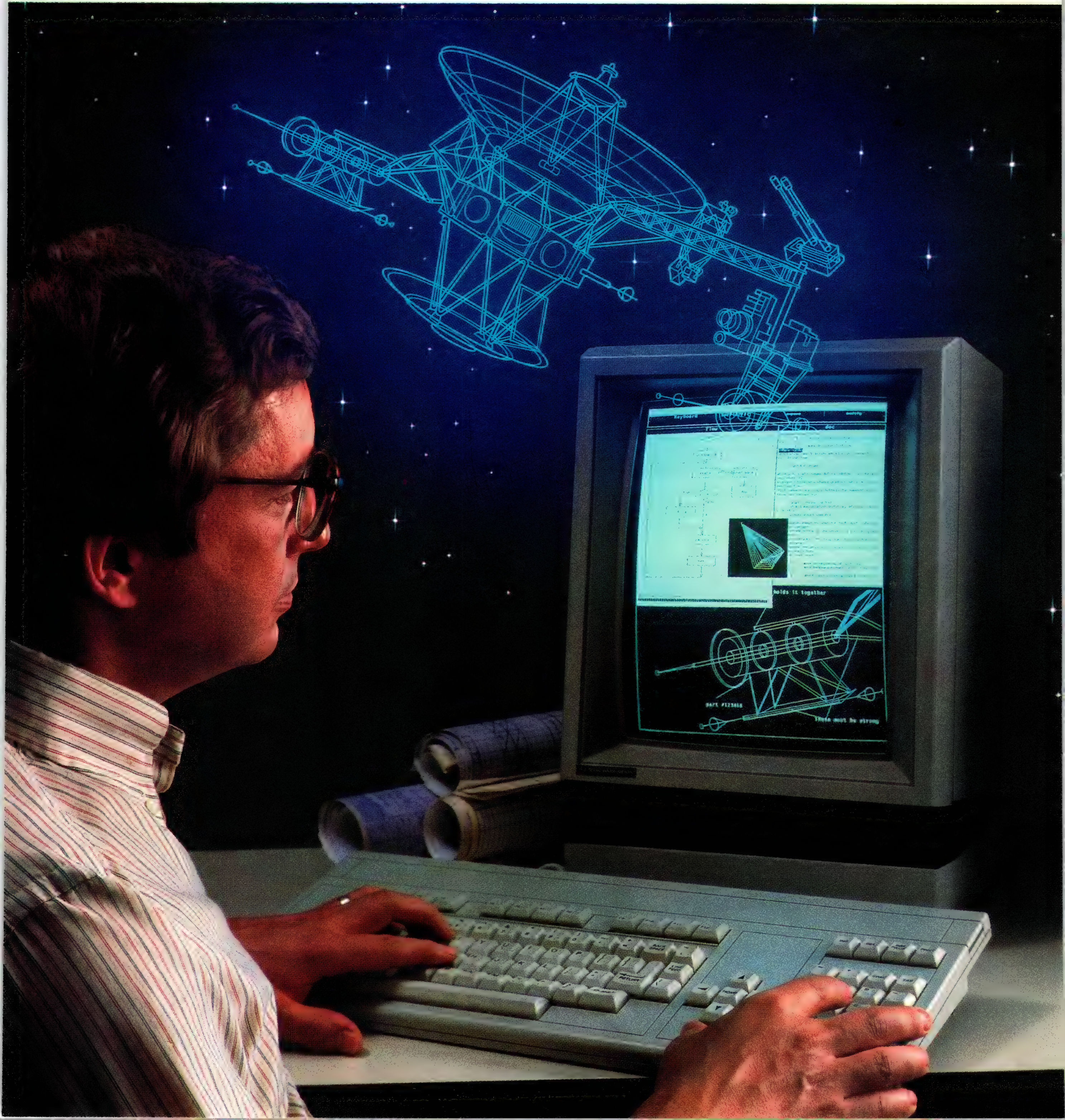

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The Nu Machine's open architecture solves your make vs. buy dilemma. Multiple-processor configuration support combines with the NuBus high bandwidth, high-resolution graphic displays, cache memory, and high-speed disks to make the Nu Machine system attractive to sophisticated end-users, systems integrators, and OEMs in the engineering and scientific marketplace.

Anticipating industry trends, the power and expandability of TI's Nu Machine allow it to accept 32-bit processors of the future.

Open system supporting industry standards

TI's Nu Machine system is currently available with a 10-MHz 68010 processor supporting a UNIX™-based operating system with enhancements for windowing and high-resolution displays.

Those who want to design their own system processors and controllers can now license the NuBus design from Texas Instruments.

Also, a NuBus-to-Multibus™ converter allows the use of existing interface cards and peripherals from third parties.

The system you can build on from now on

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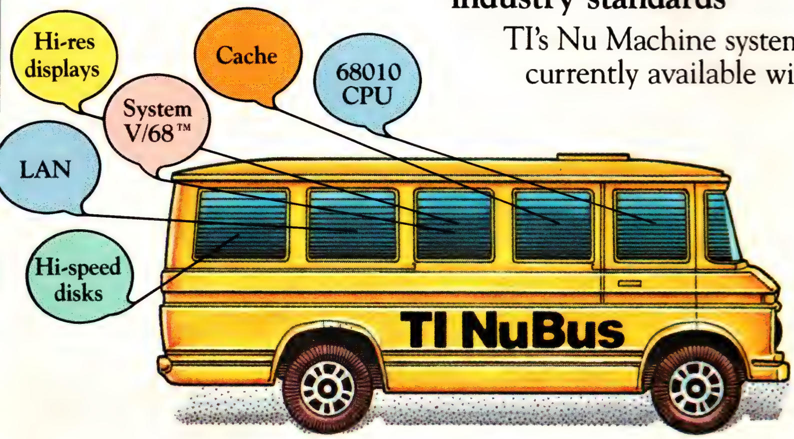

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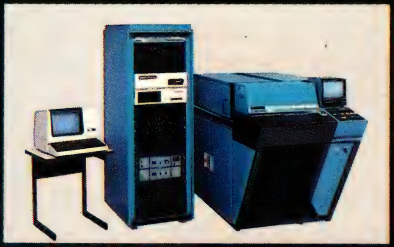
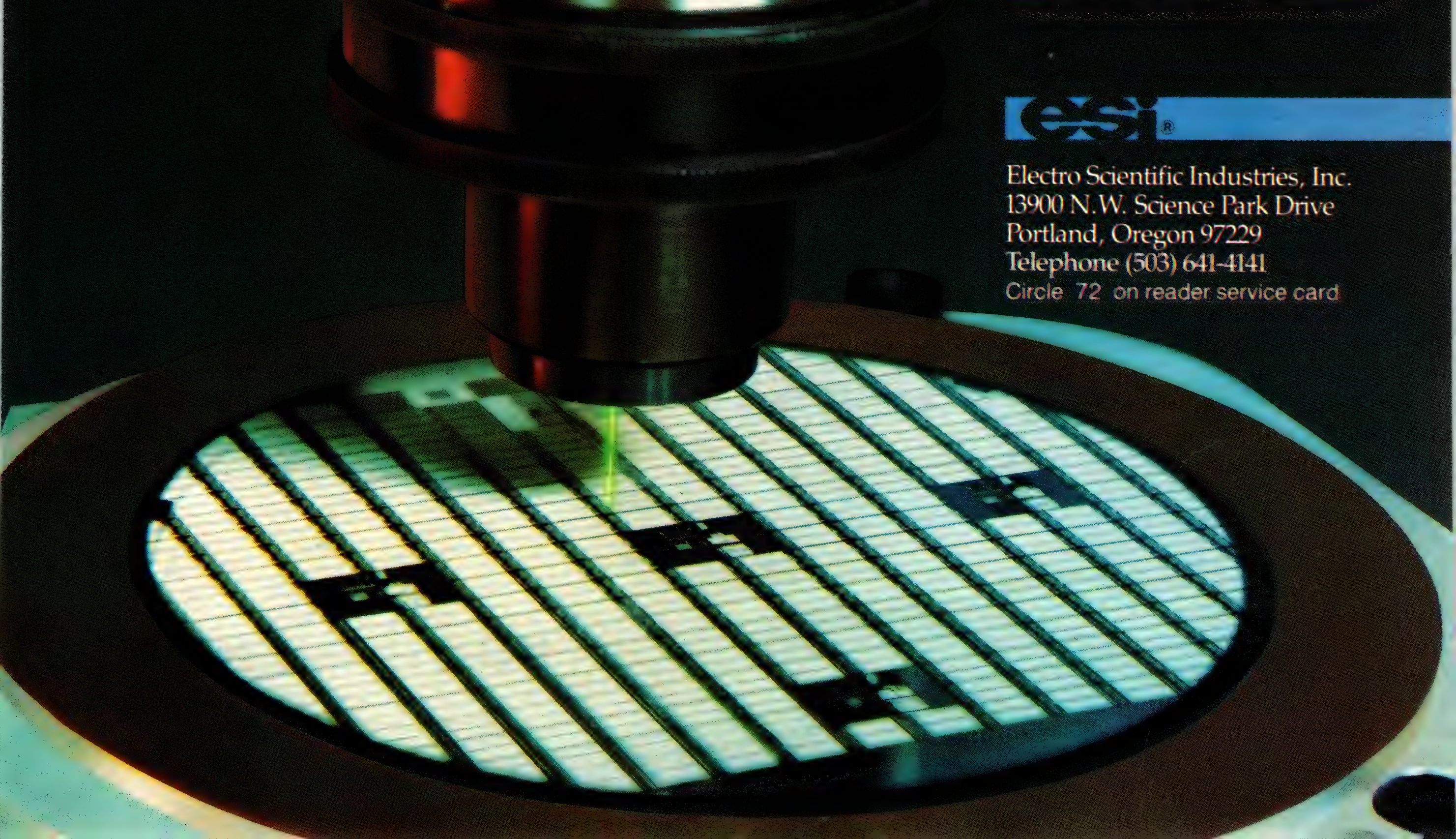


(Above) ESI's Model 44 Laser Trimming System for hybrid circuit trimming.

(Below) ESI's Model 8000 Laser Processing System.



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Significant developments in technology and business

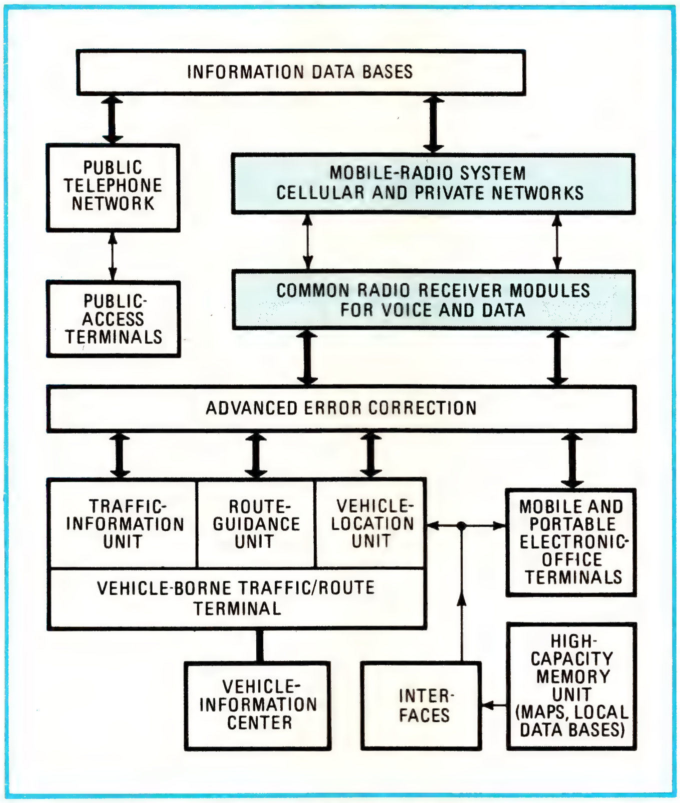
Mobil-terminal project targets on-road data for British motorists

by Kevin Smith, London bureau manager

Information system will phase in advanced range of facilities and could wind up saving as much as $2 billion a year

Within a few years, British motorists may be tempted by a range of fancy new mobile terminals offering such services as route guidance, vehicle location on a moving map display, voice-synthesized traffic information, and even mobile office facilities—as long as an ambitious collaborative research effort lives up to expectations.

This dazzling range of facilities would be offered at an economical price by the extensive use of very large-scale integrated-circuit technology to create an expert computer system providing nonvoice mobile information services for dashboard terminals. It could achieve savings of up to $2 billion a year by easing traffic-flow problems and reducing road maintenance and accidents, according to Britain's Road Research Laboratory. The first basic systems would be developed within three years.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VEHICLE-BORNE TRAFFIC/ROUTE TERMINAL
HIGH-CAPACITY MEMORY UNIT (MAPS, LOCAL DATA BASES)
VEHICLE-INFORMATION CENTER
INTERFACES

On the move. Under Britain's five-year plan, facilities can be added to a basic mobile terminal to provide many advanced integrated services.

The five-year program, involving a consortium of 16 UK organizations drawn from industry, universities, and government research bodies, plans to develop vehicle terminals for route guidance and vehicle location, as well as to receive local road-traffic information. Other terminals in the integrated range will provide such mobile office facilities as word processing, facsimile, and telex.

Novel man-machine interfaces will be developed as part of the project. For example, detailed road maps held on video disk or in read-only memory will be presented on a high-resolution liquid-crystal display while a voice synthesizer guides the driver. Eventually, the service will include voice recognition. The complete service will include permanently installed vehicle terminals as well as portable hand-held terminals linked to a remote data base through the vehicle's base station.

The $10.5 million mobile-information-systems project [*Electronics,* June 28, p. 64] is one of four large-scale demonstration projects that are being funded under the UK's Alvey fifth-generation-computer program. The others are for the development of a flexible manufacturing system, a project led by GEC Electrical Projects Ltd.; a continuous-speech recognition system, being led by the Plessey Co. plc; and a project led by ICL plc to apply rule-based expert-systems techniques to large government organizations, such as the Department of Health and Social Security.

Racal Research Ltd., in Bracknell, Berks., is heading up the work on the mobile information system. The project's cost is modest considering the range and variety of terminals to be developed, but those funds are intended to cover only research into the enabling technologies, says Keith Thrower, managing director of Racal Research. Producing prototype systems will cost considerably more than this and will be funded by individual companies.

The consortium will take advantage of developments in other Alvey demonstration projects, says Thrower. For example, Thrower expects to utilize the results of a Plessey-led project to develop a speech-recognition system with a 5,000-word vocabulary that can work with any speaker. Another Alvey project will be to deliver a large-area high-resolution LCD that is of immediate application in the vehicle map display.

If this Racal-led project succeeds, it will help to establish the company as a major supplier of advanced mobile-radio systems for civil applications. Until recently, Racal Electronics plc has been better known as an international supplier of strategic and tactical military communications systems. Then last year, its joint subsidiary with Millicom Inc., Racal-Vodofone Ltd., was awarded a license to operate one of two planned cellular-radio networks in the UK.

Piggyback. Racal plans to build its proposed mobile information system on the back of this cellular-radio service—although the mobile terminals can also be operated on existing mobile-radio networks. The national cellular-radio network, comprising some 400 base stations, would be used for local road-traffic information. A central data base fronted by an expert system would sift through road-traffic data supplied by the police, road-works departments, and other sources; organize it; and route a carefully formatted message to the appropriate base station. This data will either be transmitted to the cars' mobile units and shown on a small LCD or drive a voice synthesizer.

The cellular-radio network could also provide a rudimentary vehicle-location system, tracking a vehicle's movements from cell to cell. This information could be supplemented by radio beacons at several thousand major road junctions throughout the British Isles.

A more advanced version is now being investigated by Racal Positioning Systems Ltd.: the possibility of employing its chain of coastal positioning stations, used by the oil industry, to site exploration rigs to an accuracy of 30 meters. According to Iain Teunon, Racal Positioning Systems' technical director, backscattered radiation from this coastal chain could be used for a system that positions vehicles on land.

Finally, routing information could be provided from a central data base. London-based SIA Computer Services Ltd. already offers a computerized routing information service covering the British Isles, and Racal would likely link with SIA to develop this aspect of the service.

Business systems

Intelligent copiers expand functions

An intelligent copying system that uses a cathode-ray-tube monitor to present the results of its wide range of graphics-processing alternatives before hard copies have been made is sure to stop crowds at the National Office Machine Dealers Association show, in Dallas, from July 11 through 14. Japan's Matsushita Electric Industrial Co., attempting to increase its penetration of the growing office-equipment market, will offer two of the copier's major subsystems within a year.

One of the subsystems slated for early introduction is a high-speed, high-resolution document scanner (See "Advancing the state of the art in image scanning," below) that requires only 1 second to convert an A-4-size document into its digital electrical image with a resolution of 16 dots per millimeter. The other subsystem is a combination laser printer and conventional analog office copier; in the laser printer mode, this system has the same 16-dot/mm resolution that the scanner has. An earlier unit of this type, but with lower resolution, was developed by Hitachi's Central Research Laboratory [*Electronics,* June 16, 1982, p. 83], but it has not yet been introduced as a product.

Easily manipulated. Other components include the CRT display, a digitizer tablet for manipulating the text or graphics on it, and a graphics processor. The tablet is for use by persons operating a stylus, which resembles a ballpoint pen, to manipulate elements shown on the display.

The graphics processor, which includes two pages of memory with a total capacity of 4.5 megabytes, makes any changes called for within 0.5 s. Redundancy elimination of the type commonly used in facsimile

Advancing the state of the art in image scanners

A bipolar large-scale integrated-circuit linear image-sensor array using silicon phototransistors and emitter-coupled-logic decoding circuits helped Matsushita engineers build an image scanner that is both fast and compact. The phototransistor array spans the full width of a document and can therefore be used in the contact mode—separated from the document by a light guide that is several centimeters long—rather than requiring the 30-cm or larger spacing common for sensors of reduced size [*Electronics*, Sept. 22, 1983, p. 85].

Because a single monolithic silicon array cannot be made with the 224-millimeter width this system requires, Matsushita assembles eight chips measuring 28 mm by 1.7 mm on an alumina substrate. Difficulties that had to be overcome include the precise alignment of the chips and the fabrication of the end phototransistors close to the scribe line. The 62.5-micrometer center-to-center spacing of the 26-μm-wide phototransistors is maintained between and on chips. This technology's beauty is that the chips' parallel operation lets a single line be scanned in 0.2 millisecond. Decode circuitry permits random access during scanning.

Another example of the system's innovative technology is a linear motor that moves the image-sensing array along a document's length. An organic photoconductor belt made it possible to design the laser-printer unit with a lower profile than would be possible with the usual photoconductor-coated drum. **–Charles L. Cohen**

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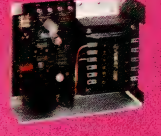

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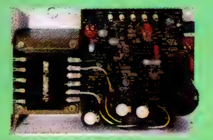

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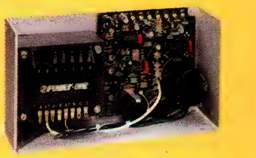

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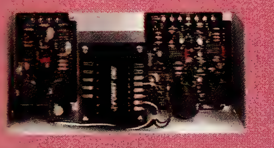

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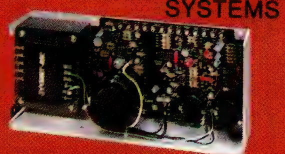

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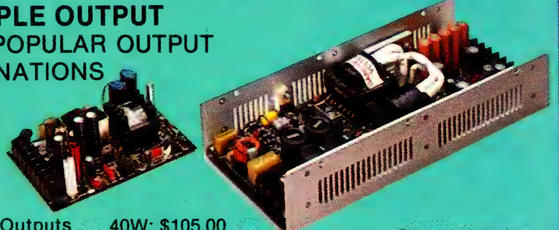

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Smart copier. Matsushita laser copier system to be shown at Dallas includes scanner, far left, display and tablet (with gray surface), and combination laser and analog printer, right.

would have permitted a smaller memory capacity, but Matsushita engineers opted instead for fully mapped page memories in order to speed up graphics processing. An 8088 microprocessor controls the graphics processor, and special-purpose hardware is used for high-speed graphics processing.

The menu of graphics-editing options that can be tried out before copying is quite extensive. For starters, there is size reduction and magnification, as well as trimming and masking. Defined portions of the original can be moved or interchanged, or portions of two different documents can be combined. Black and white reversal (negative to positive) and left-to-right reversal (mirror images) are included. Also possible is the overlay of forms or ruled lines from memory. As an aid to editing, the display includes zooming, scrolling, black and white reversal, and overlays. –**Charles L. Cohen**

Solid state

Philips develops a stereo version of its fast-selling fm receiver chip

Designers at the Philips Electronic Components & Materials (Elcoma) division, in Eindhoven, the Netherlands, have kept a promise they made early last year: they have created a stereophonic version of their miniature fm monophonic receiver, which squeezes practically all parts between the antenna input and the audio output onto a 3.5-square-millimeter chip [*Electronics,* Jan. 27, 1983, p. 129].

The TDA7000, which helped equipment makers build fm radios so small they fit inside a fountain pen, has sold "in the millions, particularly in the Far East, including Japan," says a marketing official at Valvo GmbH, an Elcoma affiliate in Hamburg, West Germany, where the chip was designed and is being produced. It has also been used in watches and games, as well as in calculators combined with mono fm receivers.

In the new stereo version, the TDA7020T, Philips dropped the minimum supply voltage from 2.7 volts, which demanded three battery cells for the mono chip, to 1.8 V, the end-of-life voltage of two 1.5-V batteries. This gives the fm receiver an even more space-saving fit. For stereo reception, the circuit works with a single-chip stereo decoder.

The stereo chip's basic operating principle—a change in the conventional superheterodyne principle—is pretty much the same as that of the mono version. The Kasperkovitz principle, named after Austrian-born Dieter Kasperkovitz, a researcher at the Philips Research Laboratories, in Eindhoven, reduces an fm receiver's nominal intermediate frequency of 10.7 megahertz to 76 kilohertz. That low i-f value provides excellent selectivity and permits the critical tuned-LC filters to be replaced by easy-to-integrate RC types, which greatly reduce the need for receiver adjustments.

The Kasperkovitz principle also entails the use of a unique correlation-muting circuit for suppressing such spurious signals as interstation noise and the two unwanted side tunings that are present when fm signals are demodulated. The noise and the side-tuning suppression occur simultaneously. To achieve this, the square-wave i-f signal is compared with its inverted version and delayed by 7 microseconds, or half of the period of the 76-kHz i-f.

Noise-free properly tuned signals are virtually identical to their inverted versions; that is, they have high correlation. Noisy or detuned signals differ in easily detectable ways—low correlation—and can be suppressed. The mono-fm-receiver chip based on this principle recently won Kasperkovitz the Veder Prize, from the Veder Scientific Radio Fund Foundation in the Netherlands, for "creativity, systems insight, and technological know-how."

Details differ. Although the 7000 and 7020T use the same basic principles, they differ in circuit details: the 7020T meets the demand for lower power consumption and thus for two-cell operation. The use of a high-gain limiting amplifier in the receiver's filter section helped cut supply-voltage needs. Adaptations made in the standby current of the output amplifier to the output signal helped slash current consumption from 8.5 milliamperes for the 7000 to 5.7 mA for the 7020T.

"We also did a lot of work on cutting the external-components count from the original 14 ceramic capacitors that the 7000 needed," Kasperkovitz says. The designers achieved this reduction by increasing the 7020T's chip area to around 5.5 mm^2 to accommodate 5 of the 14 capacitors and also by incorporating an additional power amplifier on the

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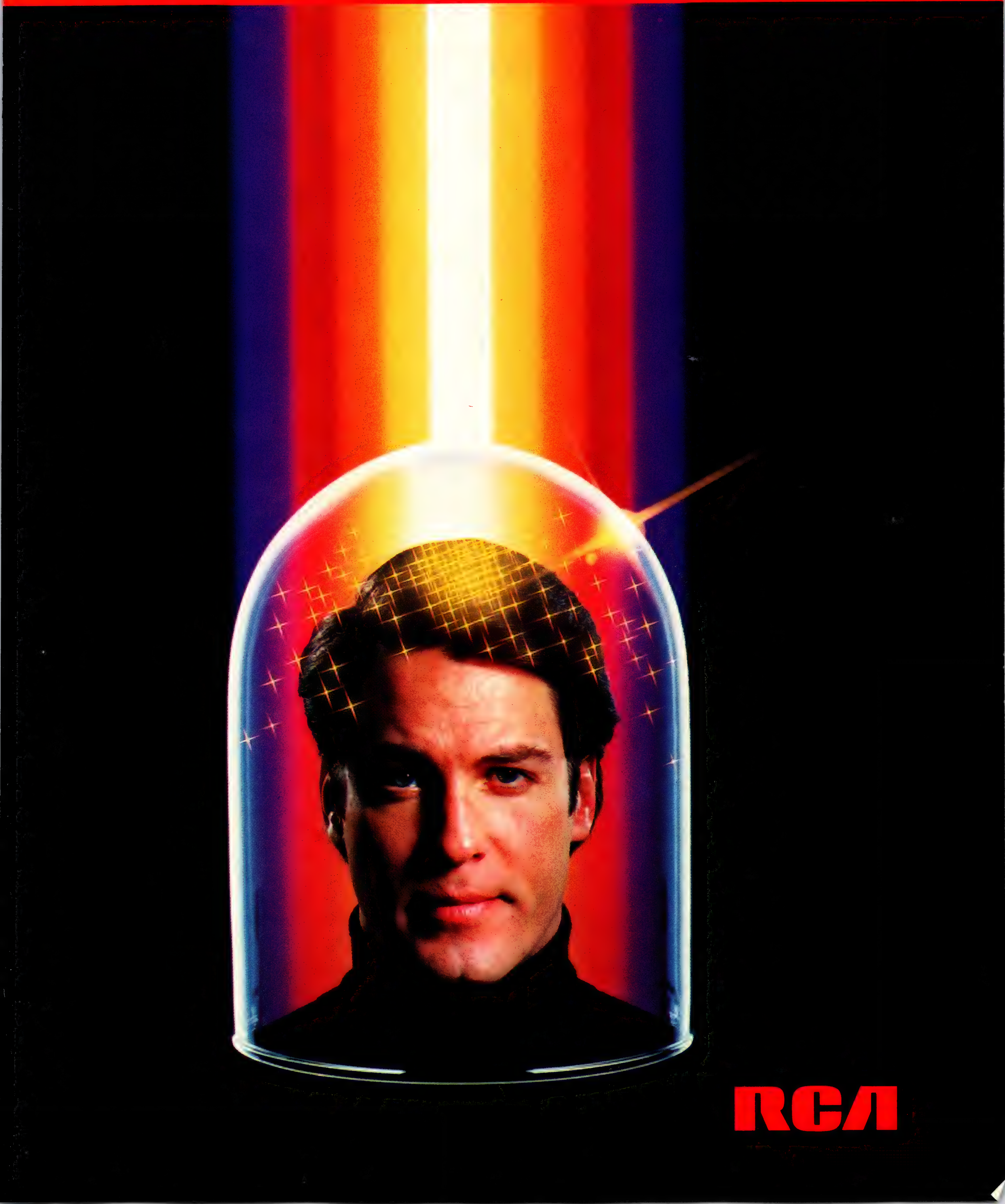

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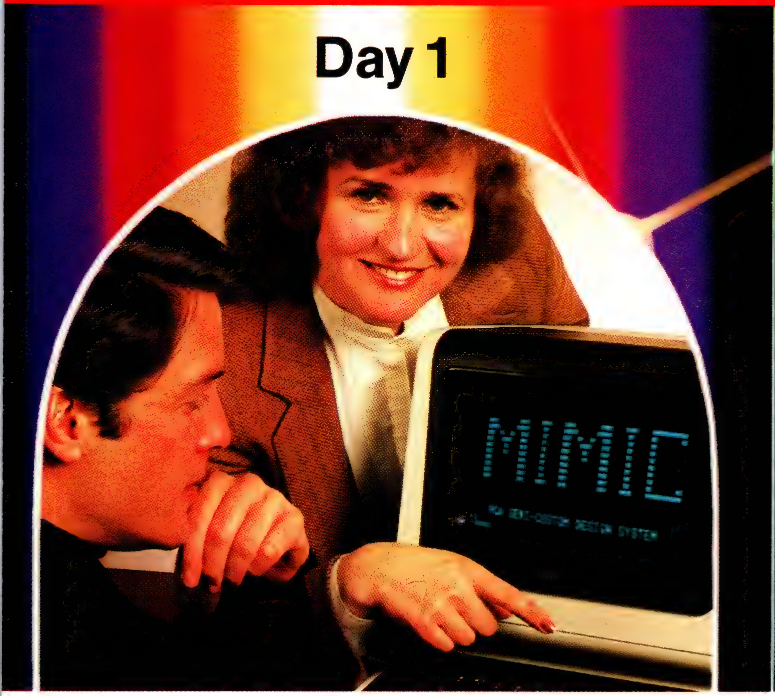

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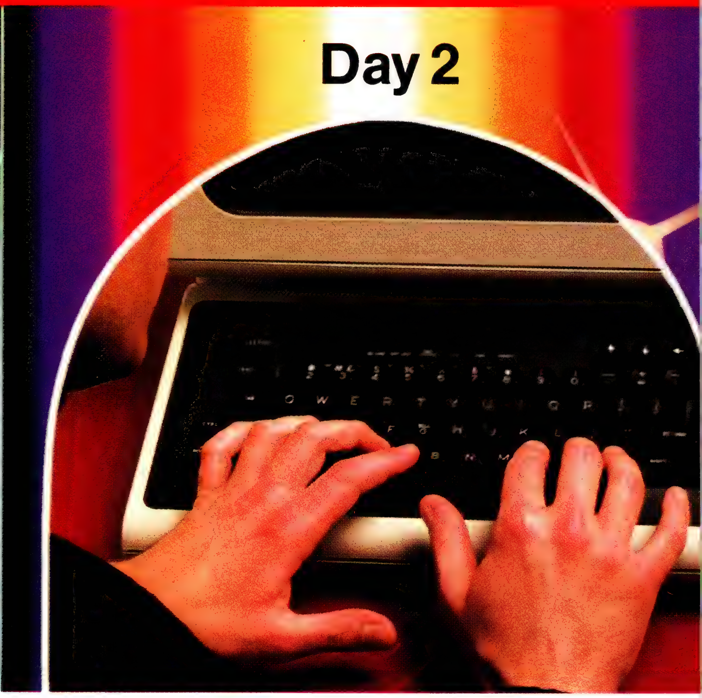

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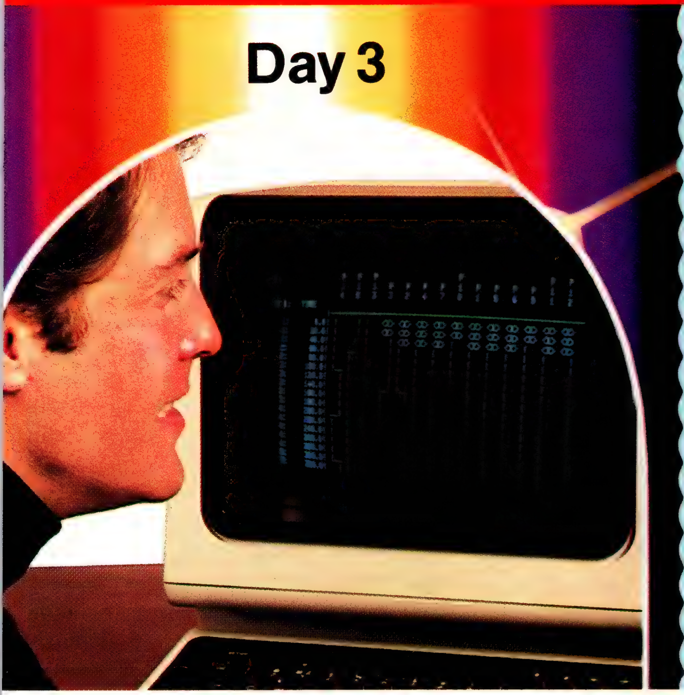

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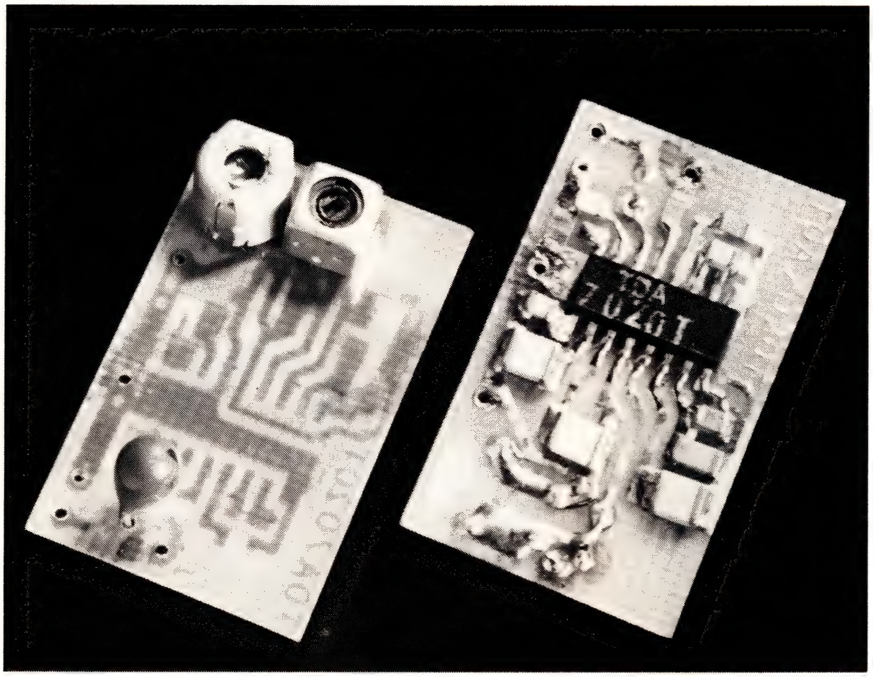


Tiny receiver. The TDA7020T (black chip), shown with its single-chip stereo decoder, is encapsulated in a 16-pin dual in-line package and mounted on an 18.5-by-30-mm board.

chip for the headphone (for monophonic use only). These two factors made for an effective components saving of 10 capacitors and 2 transistors and allowed the Philips designers to put the chip in a 16-pin package even though they added a field-strength indicator circuit and the extra connections for stereo.

Finally, the Philips designers integrated a high-Q filter into the 7020T to make it suitable for connection to a stereo decoder using quadrature demodulation. The frequency-locked-loop circuit has the characteristics of a low-pass filter with a steep slope, which passes the mono channel but strongly attenuates the 38-kHz stereo channels. The high-Q filter pushes up the gain at 38 kHz. –**John Gosch**

Computer-aided design

Battelle moves into the marketplace with three-dimensional Systrid system

Over the years, thousands of projects carried out at the Battelle Memorial Institute, an organization that bills itself as the world's leader in contract research and development, have found their respective ways into clients' product catalogs. In computer-aided design, however, Battelle's Geneva, Switzerland, laboratories have now come up with a contender that has inspired the institute to make a foray into the marketplace.

The new entry into the CAD market is called Systrid, a French acronym for three-dimensional system. Its origin dates back to the mid-1970s, when Battelle developed a CAD tool that helped design complex surfaces for the helicopter division of France's nationalized aerospace giant, Société Nationale Industrielle Aérospatiale.

Just a couple of years later, the system was operating so successfully that Battelle and Snias decided to team up to generalize Systrid for nonaerospace applications on a broad range of commercial computers. That development completed, the two organizations are now ready to go commercial, using Battelle's bases in Geneva and its world headquarters, in Columbus, Ohio, to launch Systrid on the European and U. S. markets, respectively.

Complex picture. Basically, Systrid is a surface modeler. CAD tools tend to be based on 3-d representations of two-dimensional drawings or on manipulation of volumes, such as cubes, cylinders, and cones. Systrid, however, traces its origins to multiparametric polynomial representation.

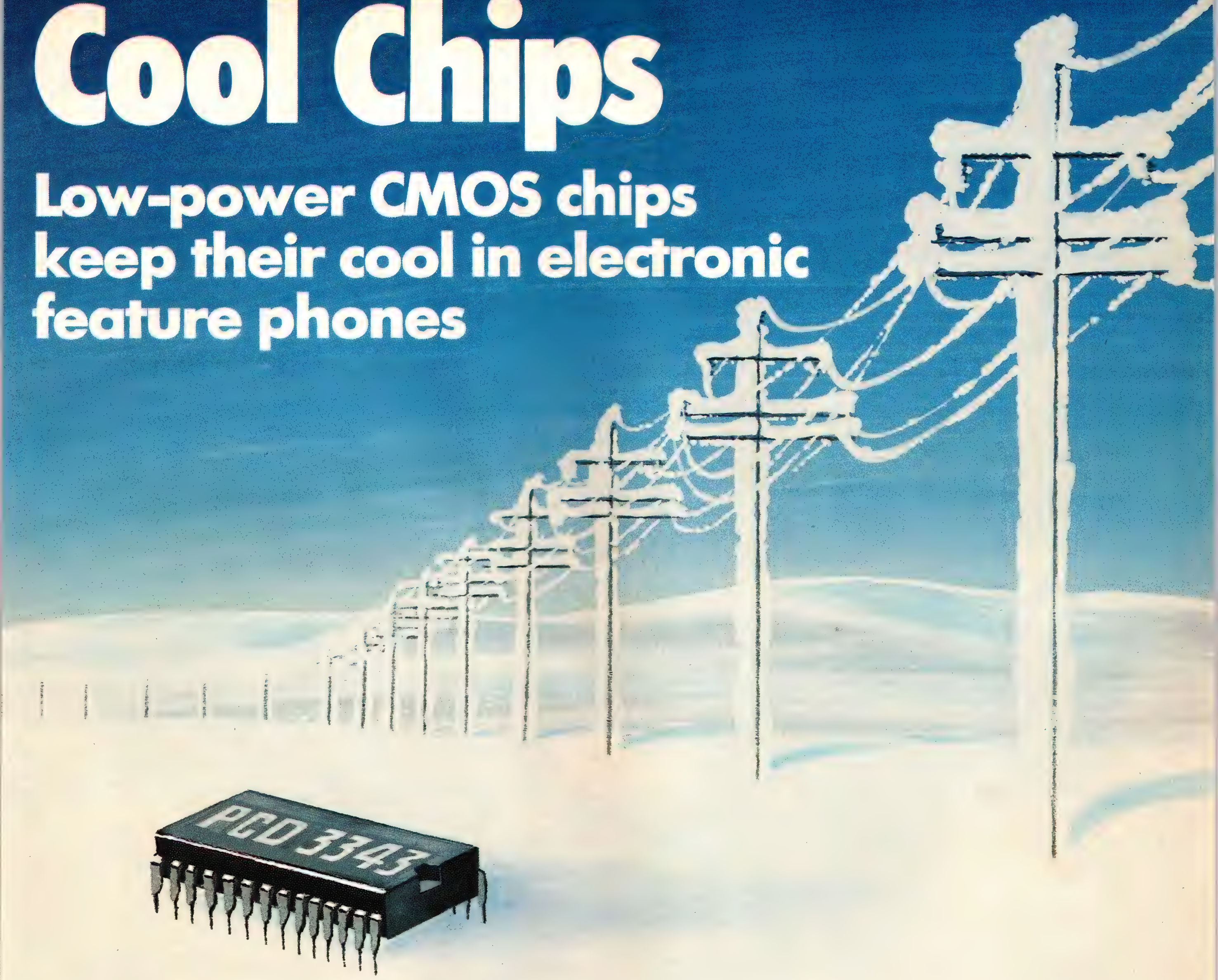
Surfaces are defined by a certain number of poles; the manipulation of a pole belonging to a surface so created implies a change in its shape and contour. That avoids the problem inherent in former systems: an exponential explosion of lines, circles, splines, and so forth, which can limit such a system's ability to deal with very complex objects. Systrid was designed to deal with complex and critical shapes, such as helicopter propeller blades, and it is more accurate than digitally controlled machine tools are.

Systrid comprises five modules. The first and most important is the design module, a program that includes about 1,000 subroutines to help designers create any two- or three-dimensional object. That accomplished, a meshing module can perform finite element calculations; a machining module can generate the output for a digital machine tool; a tracing module generates curves, surfaces, and intersection lines; and a robotics module furnishes commands for robot control from trajectories defined during design.

Battelle expects that besides aerospace applications, Systrid will find uses in the automobile industry as well as hydraulic and gas-turbine design, naval construction, and the glass and plastics industries. Currently, the system is available for use on the IBM 4331 and 3801, the Digital Equipment Corp. VAX 750 and 780, Control Data's Cyber, and Apollo computers. In addition, an adaptation for the Hewlett-Packard 9000 is now under development. Users may buy the system's design module and any combination of the output modules. –**Robert T. Gallagher**

Cool Chips

Low-power CMOS chips keep their cool in electronic feature phones



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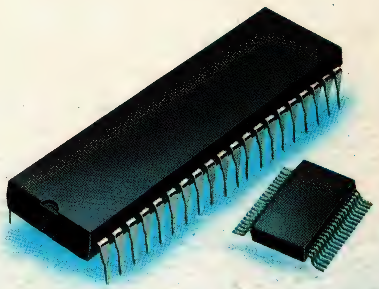
For data and samples please contact: Philips Electronic Components and Materials Division, 5600 MD Eindhoven, The Netherlands.



Philips also put the PCD3343 and other ICs in space-saving SO mini packages. Comparison shown here is between 40-pin DIL and 40-pin SO.

Making the Most of CMOS

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Circle 194 on reader service card

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*UNIX is a registered trademark of Bell Laboratories

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8048 family	●	–	●
8051	●	planned	
8086/8088	●	●	●
6800/02/08	●	–	●
6805	●	–	x
6809	●	●	●
68000	●	●	●
68010	●	●	●
Z80	●	●	●
NSC800	●	●	●
8400 family	●	–	●
2650	●	–	●
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Circle 195 on reader service card

Once ‘top sergeant,’ she makes top brass

Her students called her *der Feldwebel*—the top sergeant—when Barbara Wix taught computer subjects at the Control Data Institute in Frankfurt, West Germany. But it was only by taking a forceful, no-nonsense attitude “that I could gain recognition and prevail as a woman in a male environment,” she says.

Educator. Barbara Wix will be building up a department that devises curriculums and organizes computer courses for the Digital Equipment GmbH training center in Munich.

Now a member of the management team at the Training Center of Digital Equipment GmbH, the Munich-based German subsidiary of Digital Equipment Corp., Maynard, Mass., Wix has advanced to *die Chefin*—the lady boss—as she has become known to people at DEC who were her students a decade ago. That nickname, too, is indicative of the acceptance she has gained in West Germany's male-dominated professional world.

Her job at DEC, which Wix took on this past April, entails devising training curriculums for computer classes and, more significantly, building up a department that organizes courses with a heavy emphasis on programming and systems analysis, information-resources management, and office communications, among other areas. These courses are quite unrelated to specific pieces of DEC hardware.

Wix hopes to put her educational and organizational talents to further use at DEC by introducing similar courses at the training centers the company maintains in Cologne, Frankfurt, and Hamburg. An 11-month course costs up to $7,500, with the German government providing financial support to selected students as part of a computer-industry retraining program.

The 41-year-old Wix brings to her job the right qualifications. After studying mathematics and physics at the University of Cologne, she worked in that city as a scientific-computer programmer for what was then Bull-General Electric. She then spent four years teaching programming and related subjects at the Frankfurt Institute, continuing there as educational manager for about 10 more years. “My love for the educational field probably stems from my father's being a professor,” she says.

It has taken a rather skillful mix of tenacity, hard-nosed professionalism, and camaraderie for Wix to gain respect and recognition from those who work with her. “Becoming accepted as a female professional is a long process in a world where many managers still think a woman's place in industry is behind the typewriter,” she concedes.

Liebaut expects Matra Harris to climb out of red in 1984

Jean-Pierre Liebaut is convinced that this is his and his company's year. In the last quarter of 1984, Matra Harris Semiconducteurs should chalk up its first profit, the springboard from which it will take a shot at its first net profit for a full fiscal year, 1985.

The claim may sound familiar, since last year company officials were saying just about the same thing at just about the same time. Liebaut, Matra Harris's commercial and marketing director, explains: “It's true. That plan misfired badly, but we're on the right track this year, and I'll be very surprised if we don't deliver.”

Niches. Jean-Pierre Liebaut finds 4- and 16-K C-MOS, and the 8051, prime products for Matra Harris.

Any skeptics who say that making a profit in such a strong market is no great achievement lack historical perspective on Matra Harris. A joint venture of Harris Semiconductor Corp., Melbourne, Fla., and Matra SA, Paris, the company was founded in 1979 and began operation in the disastrous early 1980s, when some of the biggest names in semiconductors suffered ignominious setbacks. There could hardly have been a more inauspicious occasion to set up shop in integrated-circuit manufacturing.

The 43-year-old Liebaut, a graduate of the Ecole Nationale Superieure d'Electronique et de Radioelectricité, backs up his contention that Matra Harris is about ready to find its wings by pointing to a book-to-bill ratio well over 1.5. Compounding the good news, he explains, is the fact that the ratio is considerably higher for products manufactured at the Matra Harris plant in Nantes, as opposed to the U. S.-made parts the company distributes for Harris.

Another reason for Liebaut's optimism is his product portfolio. At a time when the front lines of the MOS-memory market are still ravaged by cutthroat competition, he has found a very comfortable niche with high-performance complementary-MOS memories in 4- and 16-K densities, which it has been producing for some time. Prices in this sector are holding up very well indeed, reports Liebaut, a veteran of the European semiconductor business who had 15 years with Texas Instruments (Europe) before joining Matra. Perhaps the company's masterstroke was completely stopping production of the tried, true, and distressingly cheap 8048 microprocessor and using that capacity to make the 8051 microcontroller, now one of the hottest in the central-processor-unit market.

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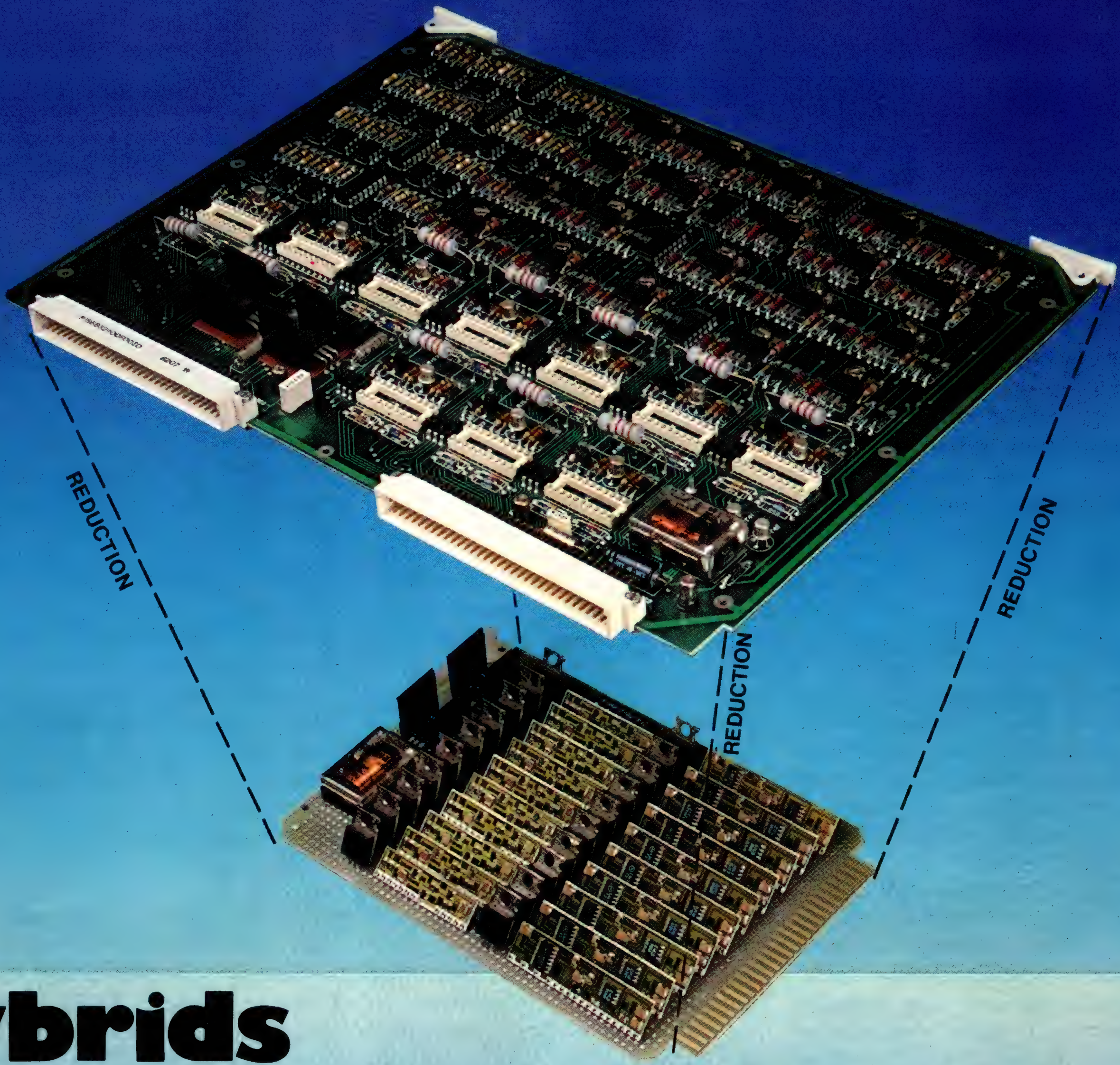

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Circle 196 on reader service card

EL display panels, 34 mm deep, fit in tight spaces

by Michael Berger, McGraw-Hill World News

Pair of electroluminescent units based on thin-film transistors weigh only 650 g; the larger has 192-by-96-mm active area

Following up on its introduction of a a 90-by-120-mm electroluminescent panel, Sharp Electronics Corp. has begun to market two larger models based on thin-film-transistor technology. The company says these units will find applications in virtually all kinds of man-machine interface tasks.

Model LJ512U05, the largest of the new orange-yellow-colored display panels, has an effective display area of 192 by 96 mm (7.68 by 3.84 in.), a dot pitch of 0.375 mm, and a pixel resolution of 512 by 256, nearly double that of the 320-by-240-pixel panel marketed earlier this year [*Electronics,* March 22, p. 117]. The second new model, the LJ640U01, has an effective display area of 192 by 60 mm (7.68 by 2.40 in.), a dot pitch of 0.30 mm, and a pixel resolution of 640 by 200.

Each panel weighs no more than 650 g and is constructed with display depths of no more than 34 mm, so both are easy to design into the tight configurations often required for office- and for factory-automation products, as well as home computers. Other applications include navigation and guidance systems, analysis equipment, and industrial-control equipment.

Sharp's thin-film-transistor technology features an EL layer sandwiched between transparent layers of insulation, with electrodes arrayed horizontally and vertically at right angles to produce an X-Y matrix. The thin design also creates a wide viewing angle of more than 120°, with an industry-standard display of 25 lines of 80 characters.

Inside job. Sharp claims that the panels have lives of 40,000 h, which is equivalent to a 20-year operating life based on a seven-hour-per-day continuous workshift. (The life of a panel is thought to be finished when it is only half as bright as it was when new.) According to the company, one reason for the high reliability is that it has built many of the major component parts itself, including the EL panel, the high-voltage MOS drivers, the printed-circuit boards, and much of the driver circuitry.

Both displays require only four TTL input signals. One serial row of data is clocked into a shift register, then shifted to the display drivers and displayed. This sequence is repeated until all rows are displayed and a new frame begins. Frame frequency is 60 to 70 Hz, allowing fast data updating and flicker-free display.

With an operating-temperature range of 0° to 55°C, the panels' typical power requirements are 5 V for logic supply and 15 V for driving the panel. Sharp is also offering optional interface circuit boards for the LJ640U01 that are fully coded for graphics as well as alphanumeric characters. Identical interface boards for the LJ512U05 will be available

sometime in October.

Samples of the LJ512U05 cost $1,739 each, and the LJ640U01 sells for $1,565. Delivery takes about one month after receipt of order.

Sharp Electronics Corp., International Business Group, Electronic Components Sales Department, 22-22 Nagaike-cho, Abeno-ku, Osaka 545, Japan [Circle reader service number 441]

Backplane and I/O expansion cards enhance popular BBC microcomputer

Users of the BBC model B microcomputer will soon be able to extend their systems with a wide range of input/output and expansion boards, many of them first developed for the Apple II. Xcalibur Computers Ltd., based in Northampton, has provided the BBC microcomputer, manufactured by Cambridge-based Acorn Computers Ltd., with an extension backplane that plugs into its 1-MHz bus expansion socket and gets power directly from its auxiliary connector.

The backplane has five expansion slots that accommodate Apple I/O and expansion cards. Moreover, it further extends the machine's performance with 64-K bytes of random-access memory.

As an Apple dealer, Xcalibur was positioned to see the potential of such an offering. Says Jeff Barringer, the Northampton company's managing director: "A major reason for the success of the Apple II—over 2 million of which have been sold worldwide—has been its backplane, into which it is possible to plug an incredible range of I/O and expansion facilities. We found many customers who would say 'wouldn't it be nice if we could do the same for the BBC Microcomputer,' " which is cheaper than the Apple and has nice graphics and networking facilities. So Xcalibur has developed this backplane to help sell a range of I/O cards, both for the Apple and for the BBC.

Typical cards already available include converters, multiport communications, multichannel counters, graphics processors, calendar/clocks, plotters, digitizers, bar-code wands and other readers, and parallel interfaces. These and other expansion cards can be taken off the shelf, plugged directly into the backplane, and run directly from BBC Basic or machine code. The Apple's I/O addresses are memory-mapped into defined addresses on the BBC, which can then drive the cards through Basic commands or assembler.

All Xcalibur Apple I/O cards are compatible with the BBC machine and documented in the manual. For those who are using personal computers to run laboratory setups, an alternative approach is to interface the computer through an IEEE-488 interface, but Barringer says that the protocols and software needed to operate such a configuration are not easy to implement. When a bus extension card is used, control routines can be written with simple Basic peek and poke instructions.

Xcalibur Computers Ltd., Spencer House, 3 Spencer Parade, Northampton, England NN1 5AB [Circle 442]

Hand-held meter performs group power measurements

The wideband level PM-40 meter, designed as a maintenance instrument for use on telephone-, data-, and sound-transmission equipment, expands its maker's range of hand-held measuring instruments. The unit has a frequency range from 30 Hz to 120 kHz, which suits it for basic group power measurements.

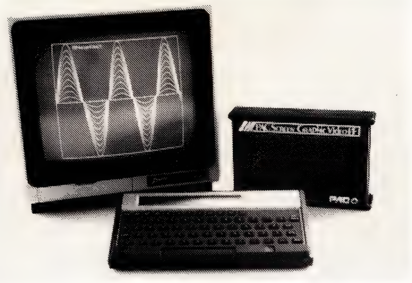
The built-in level generator, with a fixed signal of 820 Hz at –10dB/dBm from a 600-Ω balanced output, permits measurements on unoccupied channels or looped circuits. Ease of operation, accuracy, robust construction, and battery operation make this an ideal measuring set for mobile service and fault-finding on communication systems, the company claims. Available from stock, the meter sells for 1,800 DM on the German market.

Wandel & Goltermann GmbH, P. O. Box 45, D-7412 Eningen, West Germany [Circle 450]

Video interface is available for HP pocket computers

The PAC Screen Graphic Video Unit is billed as a video interface for Hewlett Packard's H-75 and H-41 pocket computers. It connects to the HP Interface Loop, appearing on the loop as two logical devices—a text interface and a plotter.

In text mode, the unit displays 80 columns by 24 rows; in the graphics mode, the resolution is 512 by 256



pixels. The syntax for the graphics instruction set is based on the HP Graphics Language and is a subset of the HP plotter HP-7470A, so software compatibility is no problem; the unit can even use the HP-41 plotter module with few restrictions.

As an additional benefit, the PAC Screen Video Unit can interface directly to any printer that has Centronics-type input, without requiring an additional interface. If an Epson printer is used, the graphics screen can be dumped on paper; in most applications, a plotter will not be necessary.

PAC Hardware GmbH, Keithstrasse 26, D-1000 Berlin 30, West Germany [Circle 444]

Interface monitor can display 10 or 11 bits of data

The RSM1-8, a monitor for RS-232-C and V.24 interfaces, indicates 10- or 11-bit-long sequences of a transmitted character on the transmit or receive lines. Depending on the operational mode, the monitor can display the first or the last word of a transmission.

This allows an uncomplicated presentation of the condition of the transmission equipment, the integrity of the data, and the transmission rate. Two 25-pole plug connectors allow looping an RS-232-C serial signal for parallel operation with a data terminal. The baud rate may be set within a wide range of 50 to 19,200 b/s. The word length can be set at 7 or 8 bits. Power supply is provided by a built-in battery or nickel-cadmium accumulator.

S. Albrecht Elektronik, Und Nachrichtentechnik, Ronystrasse 14, CH-6331 Hueneberg, Switzerland [Circle 448]

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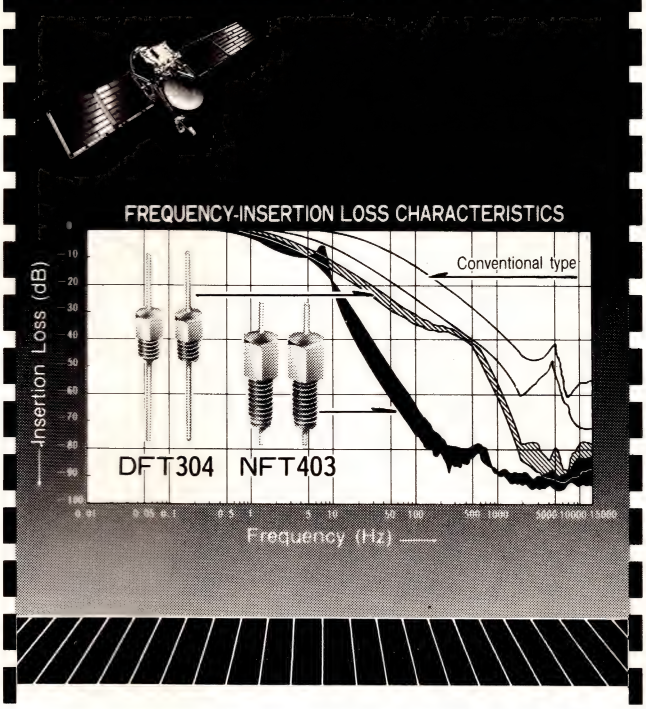

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70dB=1GHz/10GHz

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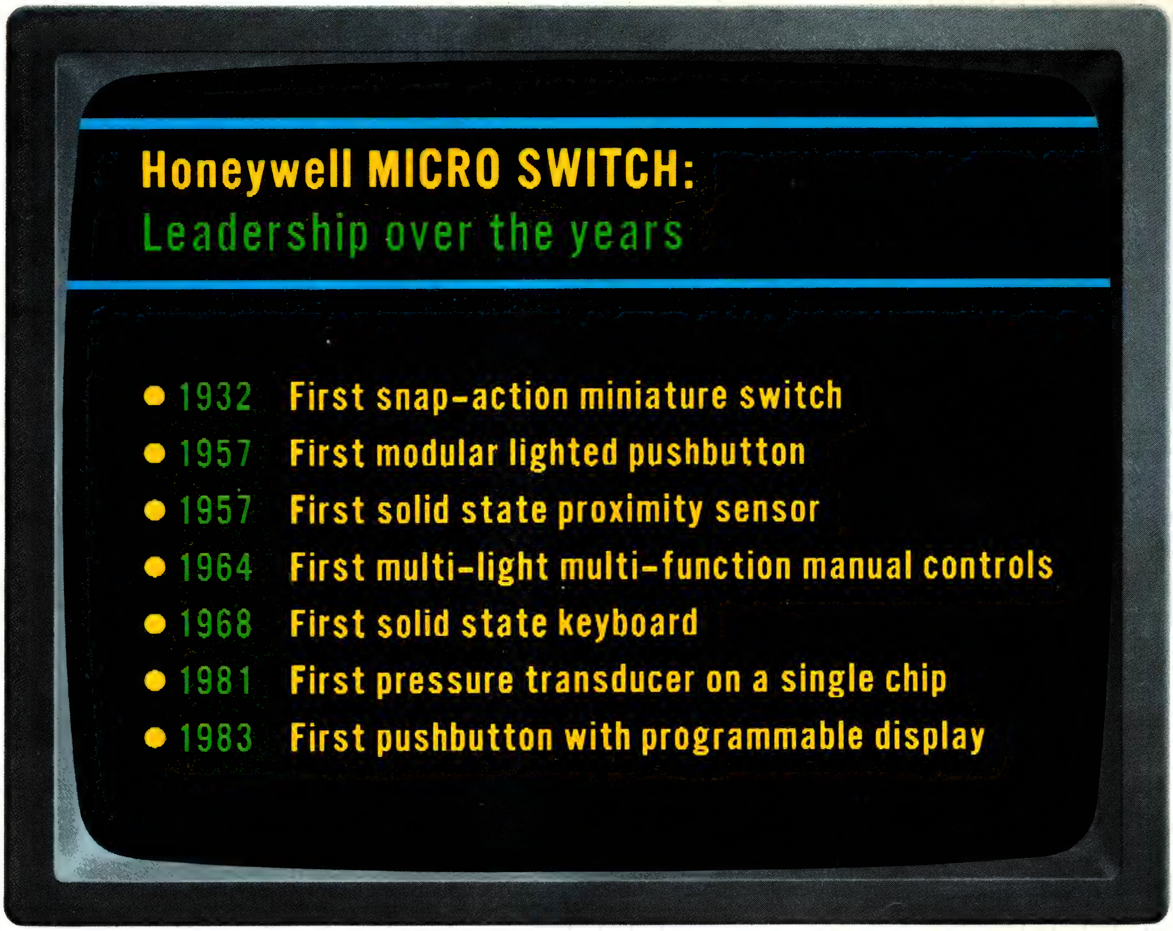

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Circle 163 on reader service card

IBM's PC plans shaking up market

A second-generation IBM PC may change the rules for compatibles manufacturers and users this fall

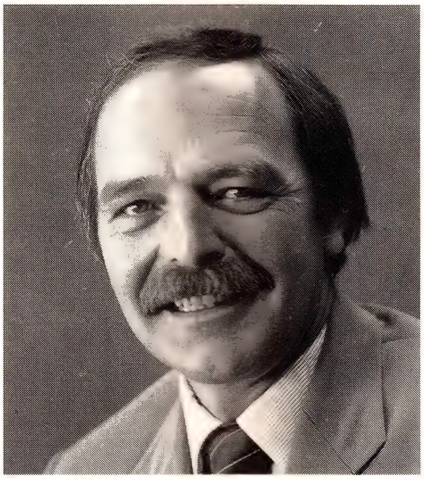
by Clifford Barney, Palo Alto bureau manager

As if its first Personal Computer hasn't done enough to shake up the microcomputer industry, IBM Corp., Armonk, N. Y., appears ready to unleash version two, a move that could again reshape the entire personal computer industry. Dealers have been told that IBM plans to ship a new computer product in the fall. This machine, says the usually well-informed cadre of IBM watchers, will be a multitasking version of the PC and will herald a new generation of IBM work stations.

Although the original PC is less than three years old, it has taken command of the microcomputer revolution and spawned machines of many stripes. Most of them are PC compatibles, or look-alikes, running the growing body of software written to take advantage of IBM's open architecture.

Standard trap. Makers of the PC look-alikes contend that the PC II (which is not an official IBM product name) will have to adhere to the de facto standard that the PC created, or IBM will lose touch with its installed customer base. "The business marketplace has voted absolutely in favor of the PC standard, and it [the standard] is independent of IBM," says Rod Canion, president of Compaq Computer Corp., in Houston. Providing they can survive recent IBM price cuts of better than 20%, Compaq and similar companies expect to flourish under the umbrella of PC II much as they did under the PC—by providing better, or cheaper, imitations.

In the brief but heady period of IBM-compatible manufacturing, knowledge of IBM's strategy and operating systems has been the key to many a successful business plan. But with PC II, times could get a lot tougher for the vendors of look-alikes. IBM has lately adopted a much more aggressive approach toward firms that have achieved PC compatibility through copying the PC's basic input/output system. In addition, it is widely suspected that the PC II will have a proprietary operating system and even a proprietary version of the Intel 80286 microprocessor (see "An Intel connection in IBM's PC plans?", p. 84).



Umbrella. Frank Zurcher, Televideo Systems Inc.'s Computer Systems Division executive vice president and general manager, sees little problem with any move IBM makes.

For the record, IBM's plans for the PC line do not seem to be targeting the compatibles manufacturers directly. Implied in statements by IBM insiders is that PC II is planned to be essentially a vehicle for bringing all personal computing back into the world of minicomputers and mainframes, where IBM enjoys its greatest success. Such a move, if it works, will up the ante on the compatibles, forcing the competition into a new round—minicomputer- and mainframe-architec-ture compatibility—that few if any look-alike producers are currently equipped to fight.

At a meeting of Canadian IBM data-processing-system users last fall, Susan P. Taylor, a senior market-support representative in the IBM Information Systems Group, said that:

- The introduction of the PC 3270 and the PC XT/370 was the tipoff to IBM's plans for mating the PC and host systems.
- These products are merely the first of a series of PC-host systems that will make the PC the basic work station for text, graphics, image processing, communications, and voice input/output. "You won't be able to keep up with all of the announcements that we will make," she said.
- The PC logic base will be the common component for all programmable work stations. "All PC programs that run on one can run on all of them, whatever user class it may be in and whatever the package may look like," she added.

The new role of the PC signals the end of an IBM tradition of "one display, one job," Taylor said. Instead of a DisplayWriter for text, a 3270 terminal for data, and yet another terminal for graphics, users will be offered one PC for all roles.

Custom chips. She also hinted that PC versions of other IBM mainframes, such as the System 36, will be available. PCs can be adapted by changing the hardware or the software. The PC 3270, for example, represents a software solution: it now offers a software package with mainframe communications, windowing for one local connection and four hosts, plus two user scratchpads. The PC XT/370 is a hardware solution: it has been enhanced with two Motorola 68000 chips, one plain vanilla and one customized to include the 370 instruction set [*Electronics,* Nov. 3, 1983, p. 47].

Other chips said to be in development will turn the PC into a Series 1, a System 36, and a variety of other IBM hardware. (It is not a simple process; delays on the special 68000 chip have reportedly set the introduction of the PC XT/370 back to January or beyond.) Such a system, Taylor continued, would link PCs and mainframes in any of several ways, mostly based on IBM's System Network Architecture and Synchronous Data-Link Control architectures, but also including private branch exchanges and local networks.

The software would not be limited to PC-DOS but could also include AT&T Bell Laboratories' Unix and, in the case of the XT/370, VM/CMS and other mainframe software. A system "hypervisor" could talk to all elements on the system.

"We will have lots of choices," Taylor said. "We have the architectural base now. We will grow much faster than you can get those boxes in and understand them."

It seems a far cry from the original Personal Computer, intended for a single user. "People at Boca Raton [location of the Entry Systems division, where the PC was developed] aren't too keen on what the other groups have done with the PC, but there isn't much they can do about it," said Robert Katsive, an analyst for Gnostic Concepts Inc., a San Mateo, Calif., market research firm.

Multitasking. The PC II, according to Katsive and other industry analysts, will be a 286-based machine with multitasking and, eventually, multiuser capabilities. The first version of the machine could be out as early as September but will probably contain an 8086 microprocessor because of a production crunch on 286 chips. If it does indeed mesh tightly with other IBM systems, that will suit at least some members of the look-alike community.

"The PC was a shock to the world—especially to IBM," says John Babbel, a puckish senior staff engineer at Mad Computer Inc., Santa Clara, Calif. "It's about time we got rationality back."

Mad—for modular advanced design—markets an advanced PC compatible based on the Intel 80186 microprocessor. It will run much PC software but by no means all of it.

"We are not an IBM clone," says founder and president John Nafeh. "We are not tied to IBM software. We designed our machine to support knowledge and intelligence. However, we must have a subset of our machine that is compatible with an industry standard." Makers of complete look-alike machines have to sell them 10% to 15% cheaper than IBM, and they cannot do that and still invest in research and development, Nafeh says. Mad prices its equipment as high as the PC.

"We start with IBM compatibility and go our own way," Nafeh says. "We will not cut prices; we will add features. We will remain compatible with the industry standard, which may be IBM's and may not be."

Nafeh insists that Mad's survival does not depend on what IBM does. "You have to look at the whole forest, not the trees," he says. "IBM will take the right conservative solution. What microprocessor they use, what operating system—these are the trees. They will influence our decisions. But the bottom line is coming up with something exciting and unique. That depends completely on originality. You don't go to the potluck empty-handed." Mad's contribution, Nafeh says, will be in the areas of decision analysis, artificial intelligence, and integrated software and hardware products.

Compaq, the phenomenally successful start-up that recorded first-year revenues of $111 million, is sticking to its proven formula of compatibility with the PC standard, which Canion considers so well fixed that IBM itself can do nothing to change it. The big question, Canion says, is whether the next generation of PC systems will deliver a step up in performance without sacrificing that compatibility. Compaq considers itself well positioned, since it has developed its own BIOS read-only memory to support software written for the PC. Using that BIOS, Compaq has introduced a more powerful version of the PC built around the 16-bit 8086 microprocessor [*Electronics,* June 14, p. 56].

A slightly different strategy has been adopted by Televideo Systems Inc., a Sunnyvale, Calif., firm that is essentially trying to sail under the range of IBM's big guns with a series of compatible but less expensive or noncompetitive systems. Televideo makes a portable computer costing under $2,000 for a system with two 390-K-byte disk drives; a 9-inch screen and 256-K of internal memory; a midrange system that it will sell with a color monitor at the

An Intel connection in IBM's PC plans?

Although Intel Corp. claims more than 300 design wins—decisions by other manufacturers to use one of its products—for its advanced, memory-protected microprocessor, the 80286, the Santa Clara, Calif., semiconductor company will not confirm if one of those designs is intended for the next version of the IBM Corp. Personal Computer. If it is not, however, the entire corps of IBM watchers will be proven spectacularly wrong. It is a given that the PC II will be built around the 286.

Announced early in 1982, this complex chip incorporates a pipelined processing scheme by which instructions may be fetched, decoded, and executed in parallel, giving it a performance capability up to six times that of the 8086 at the same clock speed. It can address 16 megabytes of real memory and has on-chip memory management that allows it to address a gigabyte of virtual memory. And most important for multiuser applications, it incorporates four levels of memory protection, keeping individual users' data separate.

The 80286 operates in two modes. In real mode, it functions like a faster 8086, accepting all 8086 software. In protected mode, virtual memory and same price IBM charges for monochrome; and what it calls a personal minicomputer, containing a 186 microprocessor, a 46-megabyte Winchester disk drive, and eight RS-422 ports, to which a number of PC-look-alikes can be attached. "Our niche in the computer business is the small-business, single-user desktop system that can grow to a multiuser system," says executive vice president Frank Zurcher.

Protected. This market, he says, is immune to IBM manipulations. "If they leave the PC II architecture open, they still have to find their own niche," he points out. "If they close it, that will be a great opportunity for us—IBM has created a mammoth base for the PC. If they add new features to the operating system, they must let the old programs run on it; and if it is compatible with the old installed base, we will be able to provide the same new functions in the time it takes IBM to get the product to market."

The smaller companies seem willing to yield the large office-system marketplace to IBM. "IBM is developing a PC family that will fit into a group of products, with communications capability, linked to its installed mainframe base," points out Maxwell Steinhart of Creative Strategies Inc., a San Jose, Calif., market research firm. "IBM will add features that make it increasingly difficult for outside-PC products to interface with that installed base. If you can get the 370, System 43, and System 38 on a desk—plus the local processing power of the 80286—that's a much better business solution than a bunch of stand-alone products that also happen to run IBM software."

Consultant Richard Dalton of keep/track, a San Francisco office automation firm, agrees that software compatibility is not the issue with the PC II. "They could no more change the PC standard than they could get out from under the 360 operating system," he states. "IBM's basic interest is in its installed customer base. The new PC will be an engine to serve this base."

The one-time rush to microcomputers running VisiCalc has reversed into a movement toward mainframe-oriented environments in which the PC is the basic work station, Dalton adds. As long as the economy grows, the existing accounts will grow with it.

Meanwhile, the PC look-alikes are still looking for new markets. Phoenix Software Associates Ltd., of Newton, Mass., has begun selling an IBM BIOS emulator that will allow most 8088- or 8086-based machines to become compatible with the PC. Phoenix insured its BIOS against copyright infringement and prices it at $100,000, according to president Neil Colvin. Despite the maturity of the PC market and the impending release of the PC II, Phoenix has licensed six new manufacturers, Colvin says. The PC II may find that the old PC isn't ready to fade away just yet. □

memory protection are invoked. This will require a multiuser operating system, such as Unix, though old application code could run as a protected task under the new operating system. The presence of IBM as a substantial stockholder in Intel, with a place on its board of directors, has given rise to speculation that IBM might turn up with a customized version of the 80286 that would outperform the standard version. The customizing mechanism could be through access to special chip instructions not available to ordinary customers. Intel has such instructions, utilized in its development systems for writing 80286 software with an in-circuit emulator.

The new chip has been in production since late last year, and Intel says it is filling all orders. Production this year will be in the hundreds of thousands of units, the company says, and in the millions in 1985. Siemens has been licensed as a second source and will come on line next year; Commodore and Sanyo have also reportedly been licensed to make 80286s for internal consumption. As for as Intel itself, it's not saying whether IBM has been granted such a license.

–Clifford Barney

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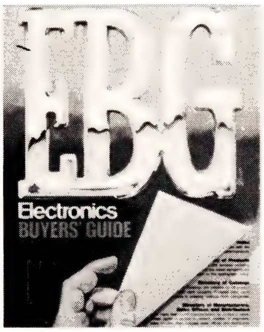

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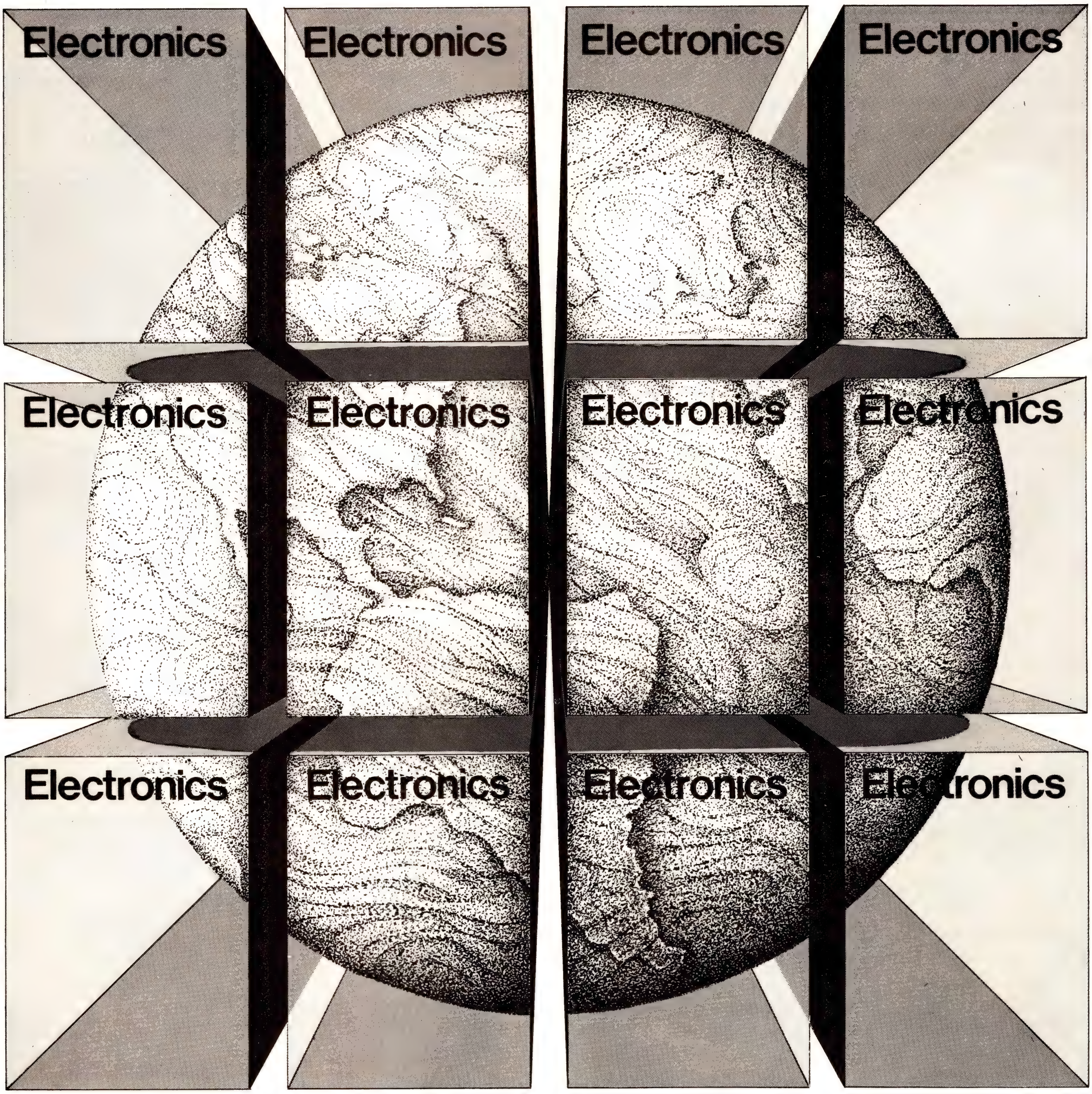

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Computer-aided design

Design show highlights two major trends

CAD/CAE moving toward design and simulation on work station as vendors and users sign design agreements

by David M. Weber, Industrial & Consumer Editor

Most of the 4,000 people who attended last month's Design Automation Conference came away with two impressions. First, it's not easy to get a hotel room or to rent a car in Albuquerque, N. M. Second, two long-standing trends in the computer-aided-design and -engineering industry are getting stronger. The first of them is the move away from simple schematic capture using software graphics packages and toward the actual simulation and testing of large integrated circuits right at the work-station level. The other is an evolution toward agreements between vendors of CAE equipment and the designers who use their products.

The major part of the show traffic passed through the booths of the Big Three: Daisy Systems Corp., Santa Clara, Calif.; Mentor Graphics Corp., Portland, Ore.; and Valid Logic Systems Inc., Mountain View, Calif. Some industry analysts compared the three to rival filling stations, each occupying a different corner of a busy intersection and profiting from the attention generated by the competitive environment.

But that sanguine view is not held at all unanimously. As Laura Canigliaro, of Prudential-Bache Securities Inc., sees it, intense marketing efforts will soon begin to make one company dominant over its rivals. At the same time, a move toward standardization, which is more or less instinctive throughout the electronics industries, will force at least some up-and-coming players out of the game. But some of the outfits now getting into CAD/CAE can easily absorb any initial losses because their other operations are so solvent.

At the conference, it was hard to imagine any established work-station manufacturer going out of business soon; the demand for low-cost models has been increasing by as much as 30% a quarter. Gerard Langeler, vice president for marketing at Mentor, sees the CAE environment as a "win-win situation, where [at least for the time being] there's room for any serious player."

Langeler believes that in a few years, engineers will not take jobs in shops that do not have a powerful CAE capability right at the desk, because so much training will be based on work stations. "As the price for CAE equipment offering full fault simulation and testing begins to drop through the $50,000 mark, work stations will be virtually everywhere," he adds.

Accordingly, Mentor sees itself primarily as a service company that must operate in an environment where the baseline technological characteristics of CAE machines may not differ very much from one manufacturer to another. Instead, success or failure will be determined by how well the CAE suppliers can tailor their product to end users.

This point was emphasized by Peter Richmond, marketing manager for semicustom products at Mostek Corp., Carrollton, Texas. In explaining Mentor's support agreement with Mostek, Richmond points out that "from the early days of MOS, it was evident that this was a technology that lent itself to custom designs. Mostek is just getting into gate arrays, and Mentor's Cadisys package had the physical-design capability we needed." Perhaps the major financial issue at the conference was the tendency of CAE vendors to sign support agreements with end users and hardware suppliers.

Jack Liskear, marketing vice president at Valid Logic Systems, described his company as "selling design solutions rather than hardware."

Together. Major manufacturers of computer hardware team up with CAE software writers for an integrated design package.

Like a majority of the other marketing people at the show, Liskear felt that the most dramatic growth in CAD/CAE would come not from improved work-station design but rather from offering the most comprehensive support package to users.

Liskear's comments were echoed by Glen Miranker, Valid Logic's director of engineering, who spoke of a "trend toward standardization in HDL [hardware description language] that will permit an interchange in the description of logic diagrams between work stations from different manufacturers." Miranker likened this development to what happened in the personal computer industry, where one software manufacturer might have several nonexclusive agreements with any number of hardware suppliers.

Valid Logic's agreements include a five-year license arrangement with Teradyne Inc., with the Boston software house supplying Valid Logic with the right to sublicense and support its Lasar Version 6 simulation software on Valid's engineering work stations and host systems.

Perfect marriage. According to Jeff Hotchkiss, manager of the newly formed Design and Test Automation Group at Teradyne, "This is the first [AT&T Bell Laboratories'] Unix implementation of Lasar software, giving us a strong product entry in the design-engineering market. Teradyne's strength, historically, has been in ATE [automatic test equipment] and logic simulation for test-program generation. Valid is a leading supplier of CAE hardware and software. By linking two organizations with strengths in both these areas, we see this agreement as a major step toward integrating design and test."

Frank Lynch, Valid Logic's director of product marketing, spoke of CAE as a "service-intensive product" by its very nature: design engineers have to develop new circuits constantly and need reliable support from the vendor who sold them their design equipment. For the same reason, Lynch says, "there won't be much of a future in the industry for those vendors who merely offer schematic-capture programs with limited simulation and fault-checking capability." Even if a designer spends "two thirds of his time writing reports and scratching his head, he's still going to need a product that can grow with his design tasks."

Daisy Systems Corp., the sales leader of the Big Three—$41.2 million in the last four quarters, versus $38 million for Mentor and $23.1 million for Valid Logic—"wants to supply the front end to the design system," in the words of Harvey Jones, senior marketing vice president. At the conference, Daisy emphasized that its new Personal Logician software—running on an IBM Corp. Personal Computer XT under PC-DOS—is not to be likened to the schematic-capture packages also touted as running on the PC.

Crippling move. Jones says that "while the attraction of another useful application for a machine that is already sitting on many engineers' desks is a valuable selling point, a company that has to rely on other CAE systems to take an engineer's design beyond the front end has already crippled itself in the market." Daisy, by contrast, is using its own application-specific hardware to handle the aspects of CAE that require power beyond the front end, including simulation and physical design.

Thus, the Personal Logician sits on the same Ethernet as Daisy's more powerful MegaLogician and Gatemaster work stations. Daisy's thinking, as Jones puts it, "is to spread CAE capability more broadly across engineering-design teams."

To that end, the Sunnyvale firm has entered into a value-added reseller agreement with IBM, which will supply computational hardware, including its PC line. Daisy will configure the machines with CAE software and support entry-level equipment with more capable packages should the end user so desire.

IBM, of course, surprised no one by refusing to discuss the extent of its involvement in CAD/CAE. The company is presumed to have a spectacular in-house design capability but has so far shown no great willingness to release it to the wider market. Digital Equipment Corp. [*Electronics,* June 14, p. 56] and Control Data Corp. [*Electronics,* June 28, p. 52] use the opposite strategy.

Other agreements announced at the conference included one between AT&T and Omnicad Corp., of Fishers, N. Y. AT&T will supply its new 3B2/300 desktop computer; Omnicad will develop CAE software and sell the whole package. Neither party seeks exclusivity. V. I. Gundanna, systems engineer at AT&T's Computer Systems division, called the agreement the first of many, and Omnicad sees matters in the same way. Michael Sohn, marketing vice president, speaks of his company "vigorously pursuing VAR [value-added reseller] licensing agreements with other major computer manufacturers and turnkey CAD/CAE system users." ☐

Up front. IBM's PC is popular for schematic capture, but most manufacturers see it only as the front end in a total CAD/CAE system.

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Inside the news

Consumer

Video-disk market finds success elusive

Pioneer and a few others are still trying, but future looks grim for once-promising video-disk players

by Wesley R. Iversen, Chicago bureau manager

Video-disk players, once projected by their makers to grab a healthy chunk of the home-entertainment market, may instead end up as curiosity pieces in science museums—examples of a fine idea that didn't sell. The sad truth is that since the introduction of video-disk technology, it has been swamped by a flood of sales for video cassette recorders.

And the waters show no signs of ebbing: some 7 million video cassette recorders will be sold this year, compared with just 225,000 video-disk players. Next year, according to the Electronics Industries Association/Consumer Electronics Group, 8 million video cassette recorders will be purchased, compared with only 100,000 video-disk players.

"It's hard to consider this an especially viable business, given the competition from VCRs," observes Raymond L. Boggs, a consultant with Venture Development Corp., a market research firm in Wellesley, Mass. Declares Joan de Regt, a senior consultant at International Resource Development Inc., located in Norwalk, Conn., "Video disk [players] could revive in a couple of niche areas, such as home games and other computer-interface applications, but it will never be a mass consumer item."

Such dire observations are backed by recent history. One by one, makers of video-disk players have completely dumped or significantly deemphasized the technology. The latest, RCA Corp., New York, jettisoned its capacitive electronic disk (CED) video-disk-equipment business last April, after pouring some $200 million into the venture. That leaves Pioneer Video Inc., with its laser-based system, as the last major U. S. proponent of consumer video-disk hardware.

Confident. For its part, Pioneer, in Montvale, N. J., is maintaining a confident posture. The firm launched a $2.5 million TV, radio, and print advertising campaign in May to promote its LaserDisc product line, and it is counting on several new hardware and software features to boost its current base of about 125,000 players. These include a new short-play 8-inch-disk format (conventional disks are 12 in. in diameter) designed to capitalize on the current rage for music video. Offering up to 20 minutes of playing time per side, the disks will sell for $10.99; 12-in. disks range in price from $19.95 to $59.95. The first Pioneer 8-in.-disk titles, available in September, will feature such popular artists as David Bowie; one hundred titles are planned by year's end.

"Videotape can't compete in this [music-video] area, in terms of price, quality, and ease of use," maintains John Talbot, the firm's vice president of marketing. The new disks will play on Pioneer's $599 LD-660 and its $799 LD-700 home video-disk players but can also play on Pioneer's new video jukebox, set for shipment this fall. Aimed at commercial establishments, such as bars, clubs, and restaurants, the $7,000 coin-operated jukebox can handle as many as 60 of the 8-in. disks. It includes inputs for multiple microphones as well as an amplifier and a mixing panel, so that a user will be able to substitute his voice for the voice of the lead singer.

In an attempt to transport to this country what is called *Karaoke* (empty orchestra), the sing-along

On the charts. Pioneer hopes for a hit with its new laser-disk video jukebox, unveiled at the Consumer Electronics Show in Chicago early last month.

fad that has become popular in Japan, Pioneer will offer a series of special 8-in. disks, priced at $14.95, that feature musical accompaniment, with the lead singer dropped out and character-generated lyrics on the bottom of the screen to lead patrons through the song. For the home market, the firm is introducing a $1,200 expandable monitor, the SD-25, that can accommodate a $70 *Karaoke* module with a reverberation amplifier and microphone hookup that can be used with a home LaserDisc player. Other SD-25 options include a $150 tuner module for receiving TV signals and a $70 RGB module for home- or personal-computer hookup.

Persevering. Pioneer's Talbot will not predict LaserDisc player sales. But at North American Philips Consumer Electronics Corp., officials project industry sales of about 65,000 laser-based players this year. The Knoxville, Tenn., firm is persevering in the consumer business by selling laser-based video-disk players under the Magnavox and Sylvania brand names, but it is maintaining a low profile. Additional U. S. sales this year will come as dealers close out the discontinued RCA line. Including about 40,000 players ordered on a last-chance basis by retailers following the RCA announcement, about 750,000 CED players are expected to be in the field by year end. Both RCA and CBS Inc. have pledged to support this base by continuing to manufacture CED disks.

At RDI Video Systems Inc., Carlsbad, Calif., marketing vice president Paul Anderson maintains that the problem with consumer video-disk sales is a failure by vendors to promote their random-access capabilities for interactive applications. RDI intends to remedy that situation with Halcyon, a home-entertainment system that relies on a Pioneer-supplied video-disk player controlled by an RDI-designed computer for interactive play. Though similar in concept to the company's earlier hit video-disk-based arcade game, Dragon's Lair [*Electronics,* Nov. 3, 1983, p. 62], the Halycon system offers increased sophistication, including voice-synthesis and -recognition capabilities, giving the user the ability to interact with and control action on the screen.

With a suggested $1,999 list price (about $1,250 for consumers who already have a LaserDisc player), the Halycon system is set for rollout in five major metropolitan markets in September. At least three software adventure games based on either a film or animation will be available at first, priced at $80 to $100 each, with three more promised by the end of the year. Despite Halcyon's ability to double as a linear playback machine for both 12- and 8-in. laser video disks, some industry observers believe the pricing is too high. But Anderson contends that response has been overwhelming since the product was introduced last month; he expects 1984 unit sales to be in the thousands.

This fall, Pioneer will also begin selling an interface adapter, priced at $250, to allow LaserDisc to link up to a home computer for interactive applications. The firm has no plans to offer software for that market, however, but will instead rely on such third-party firms as RDI and on home hobbyists, Talbot says. The interactive applications portion of the market "has the potential to grow dramatically," he adds. ☐

Market alive on commercial, industrial fronts

Although the U. S. market for home video-disk players may be on the critical list, the industrial and commercial ends of the business are showing signs of a slight recovery. International Resource Development Inc., a Norwalk, Conn., market research firm, says that player sales in these segments will rise from last year's 70,000 units all the way to 175,000 by 1986, creating a $150 million market. Major applications include industrial training and education, point-of-sale systems, and arcade games—all geared to the disk technology's random-access capability, which promotes the development of computer-controlled interactive systems.

Already, several firms—including Pioneer Video, Sony, North American Philips, and Hitachi—are vigorously pursuing industrial and commercial clients with laser-based systems. Pioneer has introduced two new industrial video-disk players during the last six months; Hitachi is set to unveil a new player at this month's National Computer Conference, in Las Vegas. Sony, too, is stepping up its commitment, with plans to build a $15-million-to-$20-million video-disk manufacturing plant in Terre Haute, Ind. (see p. 54). At least two other companies that are not in the video-disk-hardware business have announced plans to build disk-mastering and -replication plants as well.

The U. S. market may even see a new hardware entrant: JVC Co. of America, in Elmwood Park, N. J. JVC may jump in with a capacitance-based high-density video-disk format it is already selling in Japan. During last month's Summer Consumer Electronics Show, the company exhibited several business-oriented demonstration systems in a Chicago hotel suite.

The advantages of the high-density format include a cheaper disk-manufacturing process and full random access to an hour's worth of material on each disk side—twice as much as laser-based systems can access at random, JVC officials contend. Suppliers of laser-based systems counter that high-density video's access times—specified at 6 seconds maximum—cannot match the 3-s times of laser systems and that disk wear from head contact could also pose problems. Laser systems rely on a noncontact reading scheme.

Thanks to an aborted plan by JVC and several business partners to enter the U. S. market two years ago, a high-density video-disk-mastering and -replicating plant is already in place, in Irvine, Calif., and waiting to be taken out of mothballs. Considering the experience of current vendors in the industrial market, this could be an important part of any market-entry formula. "Industrial system designs typically come down to the 11th hour," making fast turnaround times for disk deliveries a near necessity, explains Ronald Butler, Pioneer's vice president for industrial sales, in Long Beach, Calif. For a premium, Pioneer will deliver up to 50 disks no more than 24 hours after a customer delivers the master tape. Meanwhile, 3M Co. reports strong business for the 20-disk-maximum 8-h service it offers at its video-disk plant in Menomonie, Wis.

Letter from Belgium

Two cultures advance IC education

In a land that produces no integrated circuits, students learn IC design and fabrication at rival universities

by Robert T. Gallagher, Paris bureau manager

In a country where there is no volume production of integrated circuits, it is surprising to hear electrical engineering students discussing details of an 8-bit complementary-MOS microprocessor they are designing and later will fabricate. But such high-technology conversations do take place in classrooms at Belgium's Université Catholique de Louvain (UCL) and at the Katholieke Universiteit Leuven (KUL), its Flemish sister institution just 20 kilometers away.

Professor Paul Jespers, who heads the program in IC fabrication at the French-speaking UCL, admits that the commercial value of this particular project is "nil." But he is quick to point out the educational value of the work, noting that when the students began the design, at the beginning of the school year, in September, they had only the foggiest idea of what an arithmetic and logic unit was.

Even if the processor never ends up driving a computer, the project is still more than an exercise in simple design theory. Before the year is out, the students will have seen masks generated for the chip and a silicon realization in the university's own 3-micrometer C-MOS process. At neighboring Leuven, the electrical engineering department is striving to get its C-MOS technology down to an impressive 1.25-μm geometry.

The existence of the two programs is all the more eye-opening considering the dearth of European engineering schools with their own IC-production facilities. Although there is an extensive program in West Germany, at the University of Aachen, no such arrangement exists in either France or Italy, countries with components houses that are active in the international market.

Singular problem. Although the languages of the two schools differ, Université Catholique de Louvain and Katholieke Universiteit Leuven have precisely the same meaning, Louvain and Leuven being the respective French and Flemish names for the same city in central Belgium, about 30 km east of Brussels. The very existence of two names for the same city is symptomatic of a singularly Belgian problem. The country is the homeland of fiercely chauvinistic peoples of both French and Dutch origins, the two groups having been in almost constant conflict for centuries. To that fact, however, tiny Belgium owes its prize of two world-class electrical engineering programs, each with about 200 students and 10 faculty members.

Belgian electrical engineering instruction traces its origins back to the the founding of a professorship in electricity at the university in the Flemish-speaking city of Leuven as early as 1900. The clash of cultures ultimately led in 1964 to separate Flemish and French classes in all disciplines, and in 1968, the original

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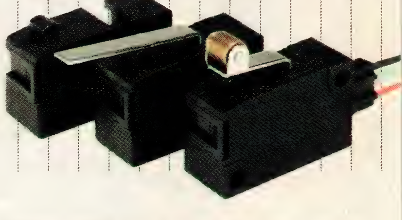

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university was physically split apart. The UCL moved to its present site in the new city of Louvain-la-Neuve, in French-speaking Belgium, while KUL remained in Leuven. Each of the electrical engineering departments has since developed its own areas of specialization.

In-house software. Besides their in-house IC production facilities, the two departments produce related software in house. Moreover, both receive government funding through the usual university channels, and they can also boast impressive lists of lucrative research contracts from industrial companies and government agencies. Both, for example, do extensive work for the European Space Agency, based in Paris. Other clients include Philips of the Netherlands, the Belgian subsidiary of ITT, and France's Centre National d'Etudes des Télécommunications.

Professors at both universities waste no time pointing out that students can only benefit from this "real-world," as opposed to purely academic, environment. The proof is that graduating students are aggressively recruited by companies from all over Europe. Those specializing in IC production have little difficulty finding posts in neighboring France, Holland, or Germany, for example.

A substantial research effort at UCL goes into telecommunications and microwave research. Professor André Vander Vorst, who heads up that department, explains that much of its work is in processing of data received from the European Space Agency's orbital test satellite, which was launched in 1978.

That project not only has high volume but high visibility as well, evidenced by a 4.6-meter parabolic antenna earth station perched on top of the building that houses the department. To make such work possible, the department developed its own transmission and reception circuits, as well as a minicomputer-driven command mechanism for orientation of the antenna.

Other department projects include studies on atmospheric propagation and very specialized work on propagation in enclosed spaces leading to communications systems for use in, say, mines and tunnels. There are also activities under way in speech synthesis and recognition, as well as a project to transmit a standard TV signal in a 34-megabit-per-second digital channel, an impressive piece of signal compression based on bit-rate-reduction techniques.

Most every student in the department at UCL, no matter what his specialty, takes some instruction in microelectronics, particularly the design and production of ICs. According to Jespers, the possibility of doing that on a more limited scale will be offered to engineering students at the other three French-speaking Belgian universities, in Brussels, Liege, and Mons. Next year, when these institutions have installed their own computer-aided-design facilities, UCL will serve as their silicon foundry.

Biomedical. Belgium's Katholieke Universiteit Leuven justly prides itself on its ambitious programs in biomedical training, C-MOS activity, and software development.

One of the KUL department's most distinguished specialties lies outside the mainstream of electronics, in biomedical applications. This activity, which is headed by Professor Wily Sansen, has run up a number of impressive successes, particularly related to stimulators and sensors that are designed to operate inside the human body.

Sansen's department has produced a fully implantable system that performs all essential functions of measurement and stimulation in the human body, as well as specialized systems to offer limited hearing to the deaf through direct stimulation of the auditory nerves [*Electronics,* May 17, p. 84]. In addition, the department has devised pressure, temperature, and glucose telemetry systems; miniature force sensors to study muscle sensitivity; and an integrated pitch-control circuit for speech rehabilitation. All of these systems are exceptionally demanding in terms of power consumption and packaging, the latter for the simple reason that they require the introduction of an alien substance into the human body.

Solar split. Both universities have extensive activities in photovoltaic conversion but are going about them in different ways. At UCL, research is oriented toward small, single-crystal solar cells that approach the theoretical limit for efficiency of such cells at about 20%. This level is achieved by beginning with a very high-grade material.

The only snags are that a complex electromechanical device is required to keep sunlight focused on the cell through a concentrator lens, and that the material itself is expensive. But the researchers are confident that they can replace the tracking mechanism with a lower-cost, purely optical configuration.

At KUL, on the other hand, the emphasis is on a screen-printed polysilicon technique aimed at finding the best tradeoff between efficiency and price. The department has reported about 10% efficiencies. ☐

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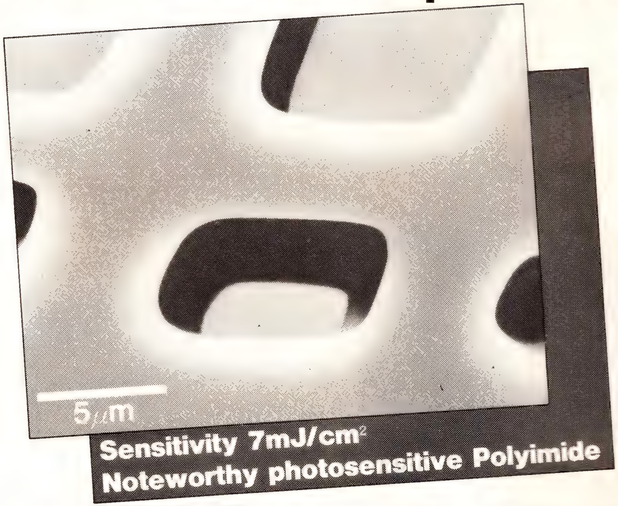

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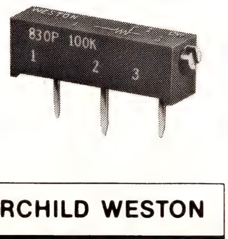

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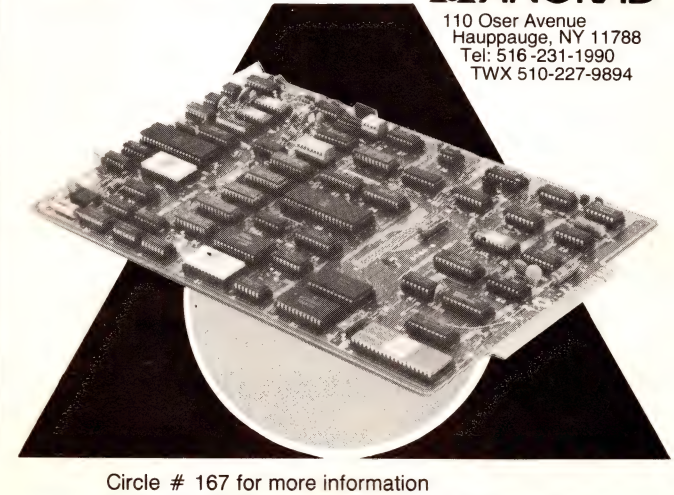

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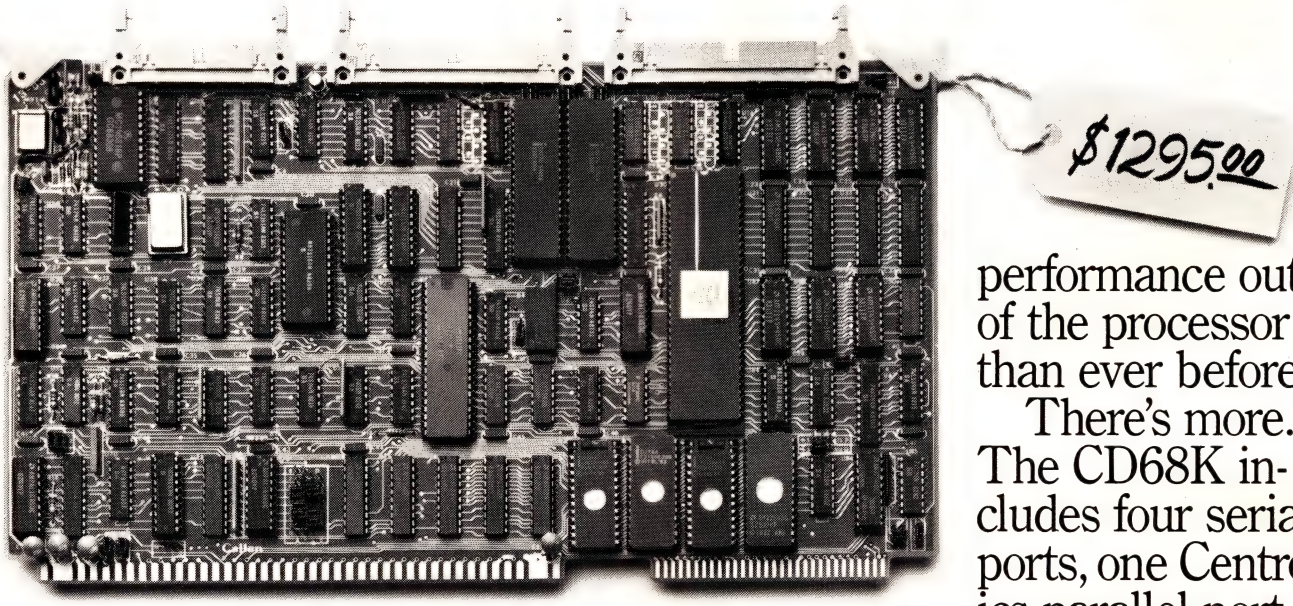

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Fast 64-bit chip set gangs up for double-precision floating-point work

With one adder, four multipliers, and four six-port register files, a pipelined floating-point processor turns out a result every 120 ns

By Fred Ware, Lyon Lin, Roney Wong, Bob Woo, and Craig Hansen, *Weitek, Sunnyvale, Calif.*

1. Adder and multiplier. The WTL 1064 multiplier and 1065 arithmetic and logic unit are n-MOS very large-scale integrated circuits in 144-pin-grid-array packages. The set, which includes a register-file chip, is configurable several ways for different levels of processing power.

☐ The engineering and scientific work stations used for such computation-intensive tasks as circuit simulation, device modeling, and nodal analysis represent only some of the markets driving the demand for high-speed floating-point processing. Along with the users of these work stations, people doing numerical analysis and digital signal processing are becoming increasingly aware of the advantages of working with floating-point processors.

To the small number of floating-point chip sets that have been developed to meet these number-crunching needs, Weitek is adding the 64-bit WTL 1064 multiplier and WTL 1065 arithmetic and logic unit (Fig. 1). Offering a performance of up to 16 million floating-point operations per second, the 1064/65 set provides full support of the 32-bit single-precision and 64-bit double-precision formats in Revision 10.0 of the Institute for Electrical and Electronics Engineers' Standards Proposal No. 754. The two integrated circuits also process data in Digital Equipment Corp.'s F (single-precision) and D (double-precision) floating-point formats and handle 32-bit 2's-complement integers as well.

Compared with board-level products, the 1064/65 set offers high-precision floating-point arithmetic at about 20% of the price. The set can replace several large circuit cards with comparable performance.

A little over a year ago [*Electronics,* May 19, 1983, p. 121], Weitek introduced a 32-bit floating-point chip set, the WTL 1032 multiplier and WTL 1033 ALU, which are available for operation at 5, 8, or 10 megaflops. They have been designed into scores of systems.

Another new chip, the WTL 1066 six-port register file, improves the performance of both the 1064/65 and the 1032/33 floating-point processor sets. Used as an intermediate data cache, it carries 32 words of 32 bits each, three read ports, and three write ports. The 1066 wrings full performance from the processors and makes the use of high-speed memory parts in the floating-point circuitry unnecessary.

The design criteria established for the 1064/65 called for speed to be the highest priority. This decision led to 64-bit-wide internal data paths and a 144-pin package. With these wide data paths and a large assortment of functions and status outputs, the chip has a size that is targeted to the upper reaches of manufacturability. In order to compensate for the large size, very conservative design rules were used to ensure high yield. In addition, extra precautions were taken to check design-rule correctness. Dracula IC layout-verification software from ECAD Inc. of Santa Clara, Calif., was used for design- and electrical-rule checking. These computer-aided-design tools helped Weitek avoid costly and time-consuming errors.

Standard n-MOS

The 1064/65 set is designed in a standard 2-micrometer n-channel-MOS process. The 1064 and 1065 measure approximately 315 and 300 mils on a side, respectively. They are housed in standard 144-pin-grid-array packages with 100-mil pin-to-pin centers, which satisfy the trace tolerances of conventional printed-circuit boards. The 2.0-watt typical power dissipation per chip permits the use of forced-air cooling, commonly found in systems combining TTL and MOS. The chips' identical pin assignments allow efficient board layout when the chips share data buses.

These two components fit well in many applications already served by the older 32-bit parts. Signal processing, graphics transformations, model simulation, and general-purpose coprocessing can very often require more range or precision than 32-bit floating-point formats provide. The 64-bit processors provide a simple upgrade path for these applications, since both 32- and 64-bit operations are performed. The bus frequency (16 megahertz) and processing bandwidth (16 megaflops) of the 1064/65 chip set match that of the 1032/33.

The floating-point standard proposed by the IEEE has enjoyed widespread acceptance by IC manufacturers. Standard 754 provides for a rigidly defined environment within which high-quality numerical software may be developed. The chip set's support of the IEEE 32- and 64-bit formats includes the signaling of invalid data with not-a-number, zero, and infinity arithmetic; four rounding modes (with separate specification for integer conversion); and the ability to operate upon and generate denormalized numbers.

Number format differences

Many existing systems use the DEC F and D formats, identical to those specified for the Maynard, Mass., firm's VAX family architecture. The F single-precision format differs from the IEEE standard in several ways. First, the weight of the mantissa's hidden bit is +½ rather than +1, and the exponent bias is +128 rather than +127. Furthermore, the exponent value of zero is reserved for true zero and for the result of operations in which the exponent overflows. DEC's standard double-precision (D) format also differs from the IEEE standard in a similar fashion. The allocation of exponent and mantissa bits is different: for the D format, there are 8 and 55 bits, respectively, where the IEEE double-precision format calls for 11 and 52.

A mode switch in the 1064/65 selects the IEEE or DEC modes. With the DEC mode, designers can easily develop specialized processors that work with VAX and PDP-11 host systems.

Like the 1032/33 processors, the 1065 has a special mode that provides for speeded-up handling of denormalized numbers. In this fast mode, all denormalized operands and underflow results are flushed to zero. In many applications, the slight increase in accumulated error is more than paid for by the simplified way of handling exceptions.

The 1064 and 1065 share a common configuration (Fig. 2). For example, each has three 32-bit data buses—X and Y for input and Z for output. The wide data paths allow the ICs to load full 32-bit operands in one step instead of stepping in 16 bits at a time. The wide internal bus structure facilitates full 64-bit operation with no sacrifice in performance through the use of complex logic for multiple-step operations. The input/output path and control signals were designed to work in a wide range of bus systems (16-, 32-, and 64-bit), so that a system designer can integrate the 64-bit floating-point parts with minimum modification of the user's existing buses. The designer simply uses the chips' mode bits and various load and unload options.

The 1064/65's instruction set is a superset of the 1032/33's to ensure family compatibility. The 4-bit function operation code used in the 1032/33 has been expanded to 6 bits in the 1064/65. Besides accounting for the addition of 64-bit operations, this step means that a wider set of functions, such as negation and compare operations, can be included on chip. Also, a wider range of absolute-value functions previously handled through software or off-chip logic have been added to the instruction set in order to simplify math operations.

Additional ease of use has been designed in through the use of six load-control inputs. The signal on the chip-select line (CSL) used for loading selects one chip of several and a 5-bit field is used to control the X and Y input buses. The load-control bits specify one or two 16-bit buses, one or two 32-bit buses, or one 64-bit bus, as well as the order in which the operands are to be clocked onto the chip. One of the bits of the load control indicates the start of a function, causing the function and operand registers to be loaded and the operation to be started.

The data path has four pipeline levels on the 1065 ALU and two on the 1064 multiplier. Multiple 1064s may be operated in parallel to match the ALU's processing bandwidth. The pipeline registers of the two chips may be bypassed for scalar (single-element) operation.

The 32-bit result (Z) and 4-bit status (S) buses are unloaded under control of the chip-select, unload (CSU) and unload (U) pins. The CSU line again allows several chips to share control fields and the result and status buses. An asynchronous three-state enable provides additional unload flexibility.

All chip registers use a conservative static design and trigger on the positive edge of the CLK^+ clock input. Separate power and ground lines are provided for output drivers to minimize noise coupled to internal power buses. Inputs and outputs are all TTL-compatible. The minimum chip cycle time is 60 nanoseconds. All inputs and outputs are characterized by a small set of parameters (setup, hold, and output delay).

The chip's architecture is sufficiently flexible to handle floating-point operations for a variety of applications. In general, the applications fall into two categories—those requiring flow-through operations and those more appropriately handled with pipelined sequences.

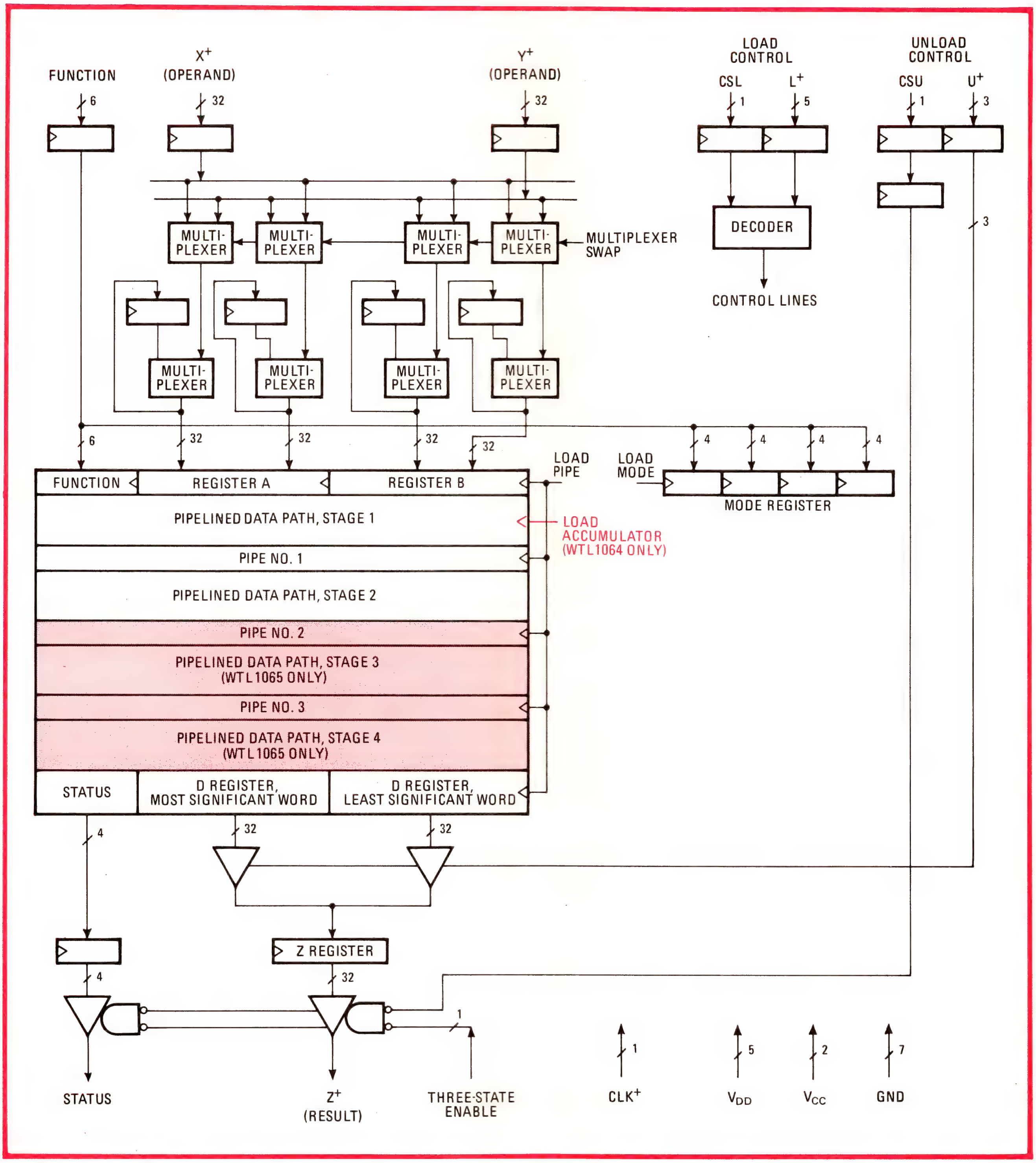
Pipeline or flow through

The pipelined sequences are those applications that fall into the standard computing requirements of digital signal processing, such as fast Fourier transforms. A classic example of a pipelined processor is the array processor. In this mode, the Weitek chips load two 64-bit operands every two clock cycles through the X and Y input ports and unload a 64-bit result every two cycles, or one result every 120 ns (Fig. 3).

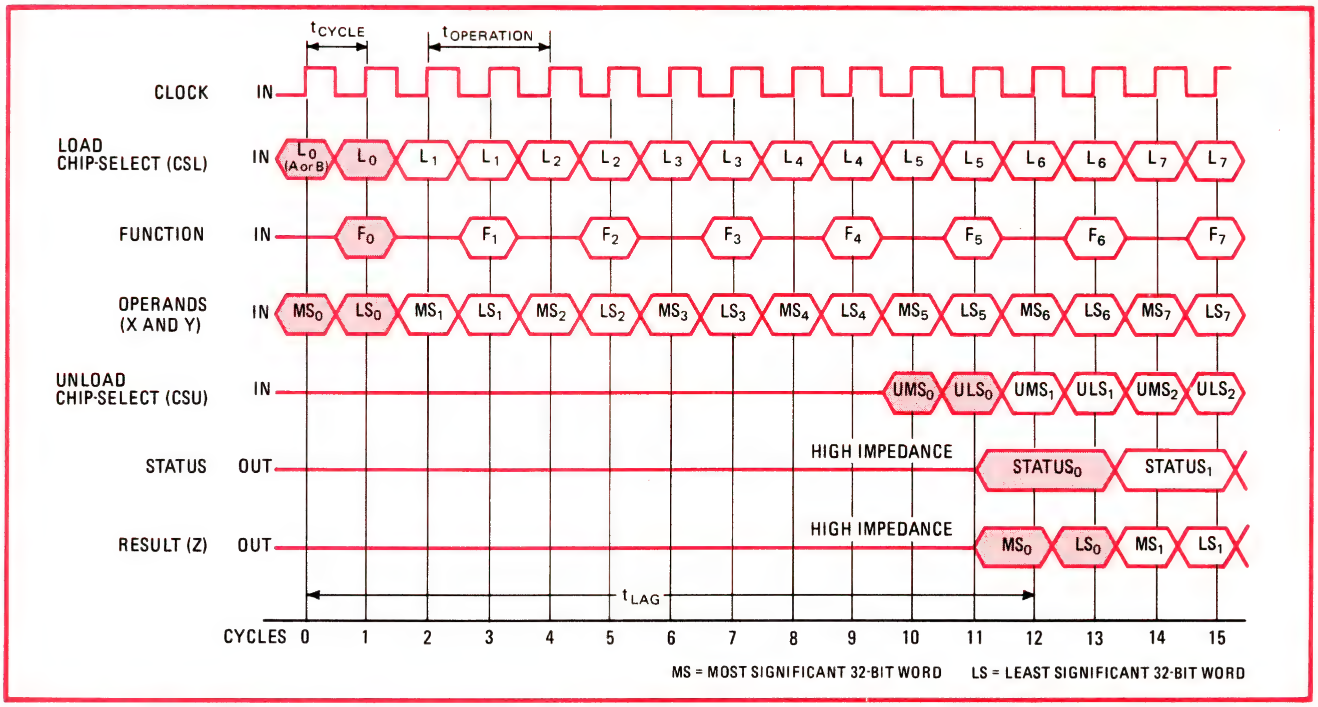
In the flow-through mode, where computations may require the result of one operation as the input of the next operation (as in analysis and simulation of electronic circuits, for example) inputs must be loaded only after the entire operation is completed. In this case, two cycles load the two 64-bit operands through the X and Y port, six cycles are spent propagating through the data-path logic, and two more are required for unloading through the Z port. Thus, flow-through operations provide results every 600 ns.

The large set of functions selected by the newly enlarged 6-bit op-code field includes, of course, 32- and 64-bit addition and subtraction in the case of the 1064 ALU. A wide range of absolute-number operations are provided, including absolute sum, absolute difference, and sum of absolute values. Moreover, a set of comparison functions are available to compare two operands, either single- or double-precision. These functions compare two operands, the absolute value of operands, or one operand with zero. Finally, the function codes handle denormalized operands. In addition, conversion between all number formats, including 32-bit 2's-complement integer, is supplied.

The multiplier's function bits handle the requirements



2. Common architecture. The 1064 multiplier and 1065 ALU share the same architecture, with the exception (noted in color) of pipeline stages: the ALU has four, the multiplier only two. Operands enter at the top in 32-bit words and results take two cycles to exit on the 32-bit Z bus.



3. Load the pipeline. In the 1064/65's pipeline mode, a 12-cycle lag follows the loading of the first words of the operands. Then the 64-bit results begin to appear on the Z bus once every two 60-ns cycles, the most significant 32-bit word first, under the control of the unload chip-select line.

lized operands. In addition, conversion between all number formats, including 32-bit 2's-complement integer, is supplied.

The multiplier's function bits handle the requirements of multiplying the two operands as well as signaling the chip whether the operation is a 32- or 64-bit undertaking. Additionally, 2 bits of the function code are set aside to handle denormalized operands. The denormalized-operand exception handling fully conforms with the IEEE 754 standard. The final 3 bits specify a variety of absolute-value and negation operations, which affect the sign bit of the result.

The 16 combinations of 4-bit status codes provide more information to the microprogrammer and allow a more detailed specification of exceptions than is the case with the 1032/33. Because the programmer can understand the exceptions in detail, he or she can dispatch exception handlers much more rapidly. The first block of status codes indicates when a zero or infinity result occurs and when a result is inexact. The next three blocks specify overflow or underflow, denormalized operands (1064 only), and invalid operations.

The exception status codes also comply with the IEEE standard. In addition, the codes are used to report the resulting condition of comparison operations. The condition codes are equal, less than, greater than, and unordered.

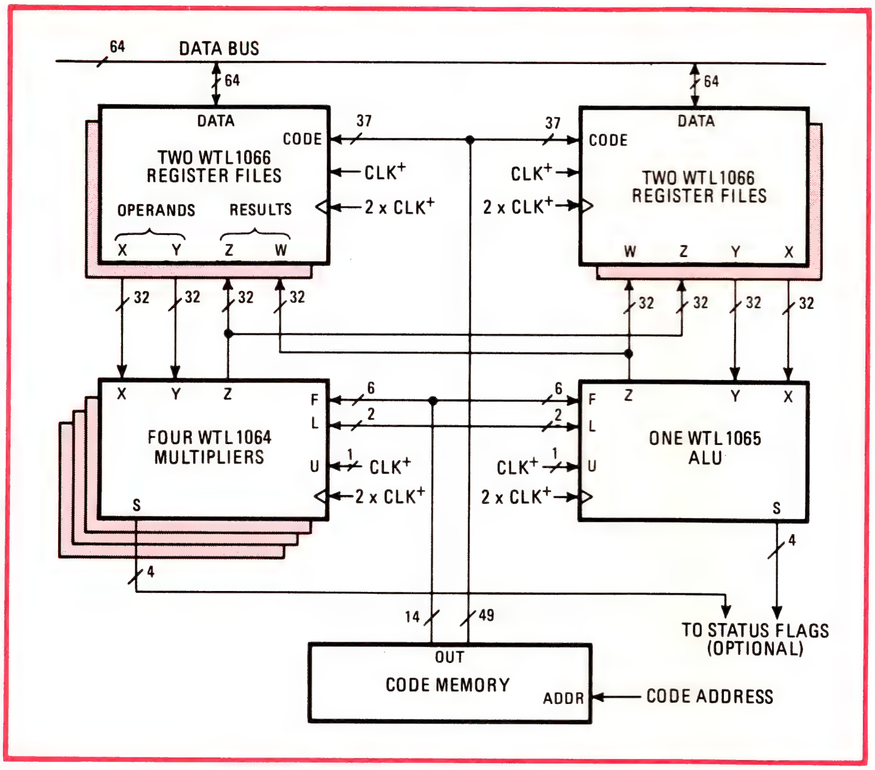
Beyond signal processing

Users' appetites for floating-point processing power have been insatiable in digital signal-processing applications such as well logging, seismic geophysical analysis, radar, and sonar. The 64-bit chip set can be used in a variety of applications ranging from low-cost single-board floating-point accelerators to attached floating-point processors that are capable of performing hundreds of megaflops to application-specific computation accelerators.

A low-cost floating-point subsystem can be built with a single 1066 register file and one each of the 1064 and 1065 ICs. The memory data bus can transform a 32-bit word every 60 ns. Two buses are used for passing operands and results between the processors and register file and between the two processors (chained operations). In a low-cost design such as this, the 1066 is a critical element in reducing board space while maximizing performance. With it, board-space requirements for this type of a subsystem are reduced from about 250 square inches to 80 in.^{2}. The area reduction results from the integration on a single very large-scale IC of registers, multiplexers, a lookup table—usually put in programmable read-only memory—and control logic.

In addition to saving space, the 1066 further reduces costs since lower-performance memory parts can be used for data storage. The 1066's 32 registers hold frequently used operands and intermediate results. The high-speed register file provides operands to, and accepts results from, the 1064/65 or 1032/33 chip set at the rate of 16 bits every 60 ns. One 32-bit bidirectional data bus, which transfers data between the register file and external data storage, can operate with either a 60- or a 120-ns cycle time.

The use of the 1066 and the 1064/65 in this low-cost configuration is appropriate when microprocessors are employed in such general-purpose numerical applications as engineering work stations. The speed of floating-point operations can be 10 times that of the coprocessors that serve microprocessors today. This can easily translate into three to five times speed-up for a numerically intensive application program.



4. Two multipliers, four. Extra multipliers and register-file chips can be used in configurations that offer more power than the basic board with one of each chip type. With four multipliers, the multiplication rate catches up to the addition capability of a single ALU.

per second. The adder in combination with two multiplier chips will perform 32-bit operations at 16 megaflops and 64-bit operations at 12 megaflops. If two more multipliers are added, 64-bit operations are processed at a 16-megaflop rate—representing 10% of the processing power of a Cray-1 supercomputer at 0.1% of the cost. This amount of processing power will fit onto approximately 70 in.^{2} on a pc board.

This subsystem has been utilized for general-purpose array-processing systems. In such a system, the registers hold intermediate results and are used for loading and storing values from a wideband memory system.

The 1064/65 chip set has been designed into one of the most powerful floating-point processor systems ever made available. The FP5-164/MAX, recently introduced by Floating Point Systems Inc., of Portland, Ore., is capable of performing 341 megaflops. It can compute up to 124 vector operations at one time, allowing a fully configured FP5-164/MAX to factor a 1,000-by-1,000-element matrix in about 1 second and multiply two 10,000-by-10,000 matrices in less than two hours.

Application accelerators

In today's markets, where engineering work stations are on the way to making fast processing power accessible to engineers and scientists, application-specific accelerators will soon become necessary to break the inevitable bottlenecks in computation-intensive research and design processes. For example, electronics engineers designing large, complex circuitry require the accurate and fast circuit simulation that these machines provide.

The combination of double-precision and pipelined operation makes the 1064/65 ideal for solving highly regular, numerically intensive algorithms, such as those found in circuit simulation. For example, the problem in circuit simulation can be represented as the solution to:

$$Ax=b$$

where A is a matrix representing the circuit topology, x represents the circuit output, and b represents the circuit excitation. While the special structures of A make specialized solution techniques applicable, in general the above equation is solved using Gaussian elimination with partial pivoting. The principal operation in Gaussian elimination is the row-elimination step, which can be represented as:

$$a_i=a_i+Kb_i$$

where a_i and b_i are elements of rows a and b in a matrix, $i=1, 2, 3, \ldots, n$, and K is a constant. This operation is regular so that the pipeline of a 1064/65 system can be kept full, permitting the chips' peak computational capability to be achieved.

Device modeling

Device-model evaluation—that is, modeling the mathematical description of a circuit element such as a MOS transistor—requires hundreds, if not thousands, of addition or multiplication operations. Again, these types of operations tend to be ideally suited for the chip set operating in pipelined fashion.

Another area in circuit simulation that is currently a problem for those using simulators involves numerical integration. For example, in nodal analysis, a typical equation is:

$$i=C\ (dv/dt)$$

where i is the current, C is the capacitance, and dv/dt is the change in voltage with respect to time. This equation is integrated to solve for the new voltage at the node. To maximize the computational throughput, the equation and data should be split up into vectors and a number of nodes computed simultaneously to make effective use of the fast processors.

The double-precision capabilities of the floating-point chip set are particularly important for circuit simulation, since the accuracy of the solution to the equation Ax=b depends on the size of the matrix A. Since A's size is directly related to the number of nodes in the circuit, larger and larger circuits depend more on double-precision accuracy to obtain meaningful results and avoid instability in the simulations. The 1064/65's high-speed double-precision capabilities can assist engineering work stations in these tasks. ☐

Designers weigh options for 256-K dynamic-RAM processes

Hidden-refresh modes make dynamic RAMs look static, while alternate addressing modes vary width of single parts

by Peter Linder, Roger Norwood, and Ngai Hung Hong, *Texas Instruments Inc., Houston, Texas*

☐ Among semiconductor products, dynamic random-access-memory chips have always been at the forefront of technology. Increasingly sophisticated on-chip circuitry has combined with breakthroughs in metallurgy, chemistry, and photolithography to reach new highs in chip density, speed, and reliability while cutting power dissipation and cost. Continued developments across this diversity of disciplines have keyed the introduction of the new series of 256-K dynamic RAMs now beginning to appear on the market.

These chips improve circuit architecture to optimize device performance, use new materials and techniques to reduce bit size and to increase speed and reliability, and adopt redundant circuitry to increase manufacturing yields (see "Redundancy lifts yield without compromising reliability," below).

But besides increasing the traditional figures of merit, such as speed and density, these chips are easy to use across a broad spectrum of applications. Consequently, they appear in a whole series of new options and configurations that make them functionally more advanced and more versatile than their 16-K- and 64-K-bit predecessors.

Because dynamic RAMs have been used primarily in large computers such as mainframes, their function, if not their internal design, has been highly standardized. Mainframes, which use large numbers of these chips surrounded by extensive support circuitry, are best served by a standard memory chip that is functionally unembellished and inexpensive. Therefore, memory-product development has been aimed largely at increasing density and speed while decreasing cost. Special control features have earned little attention, since they could be implemented at the board level and their cost amortized over a large number of memory components.

Tailor-made

Although the new 256-K-by-1-bit chips are ideal for mainframe memory systems, the presence of sophisticated computing power in a growing variety of memory-hungry applications has motivated semiconductor houses to tailor their products to new areas. In addition, the lag between generations of higher density parts—caused by an increasingly complex technology—gives design engineers more time to develop special-purpose versions of their products. At present, manufacturers answer the challenge from special-application areas by increasing the memory data rate, reducing memory granularity, and simplifying the refresh requirements.

In large systems, designers squeeze out high data rates by accessing memory cells in different chips, either in parallel or in a staggered fashion—solutions that may be

Redundancy lifts yield without compromising reliability

In the previous generation of dynamic random-access memories, redundancy was not very popular and in fact was a matter of some controversy. Nonetheless, some manufacturers used it to enhance yields or as a vehicle for gathering reliability data. At the 256-K level, however, the controversy has all but disappeared. Most manufacturers now have or intend to have some kind of redundancy implemented for yield enhancement—at least at the early stages of production.

The primary way that memory designers implement redundancy is with electrically blown or laser-blown fuses (see table). In either case, however, polysilicon has by far seen the most use for the fuse links. Both these approaches have been used by various manufacturers and have proven that redundancy will improve manufacturing yields with no adverse effects on chip quality or reliability.

COMPARING FUSE BLOWING METHODS

Electrical fuse	Laser fuse
Little additional equipment required to blow fuses	Extensive equipment needed to blow fuses
Relatively large increase in chip area	Very little chip-area increase
Additional circuitry required	No additional circuitry required
Process-dependent variation	No process-dependent variation
Potential to degrade device performance	Little effect on performance

less desirable in small systems. A small memory may not have enough integrated circuits to allow interleaving, especially as the number of bits per chip increases. Wide-word dynamic RAMs that read or write 4 or 8 bits at a time are a possible solution to this problem. These wider chips multiply the data rate by 4 (or 8) while maintaining the same memory size and chip count. (A by-9 configuration, which leaves an extra bit for error detection, has even been proposed.)

An even older solution to the data-rate problem is the page-mode cycle, which needs one complete access time (from row-address strobe) to access the first bit in a row. Subsequently, simply cycling the column-address strobe allows access to the other bits in that row, each within the relatively short CAS cycle time. Using a wide-word memory such as 64-K-by-4-bit dynamic RAMs when they become available, designers can further boost bandwidth with page-mode operation.

Nevertheless, page mode is still too slow for some applications that use a single bit-wide chip. In these cases, chips such as Texas Instruments Inc.'s TMS4257 offer an alternative, called nibble mode, in which a single bit access in fact accesses four bits internally, though only one is actually transferred. Each of the other 3 bits can then be rapidly accessed in sequence by toggling CAS, as is done in page mode. Because the typical cycle time from one nibble bit to the next is 40 nanoseconds, this approach results in a very high burst data rate. No chip is now capable of both page and nibble modes, because both are implemented by toggling CAS with RAS low.

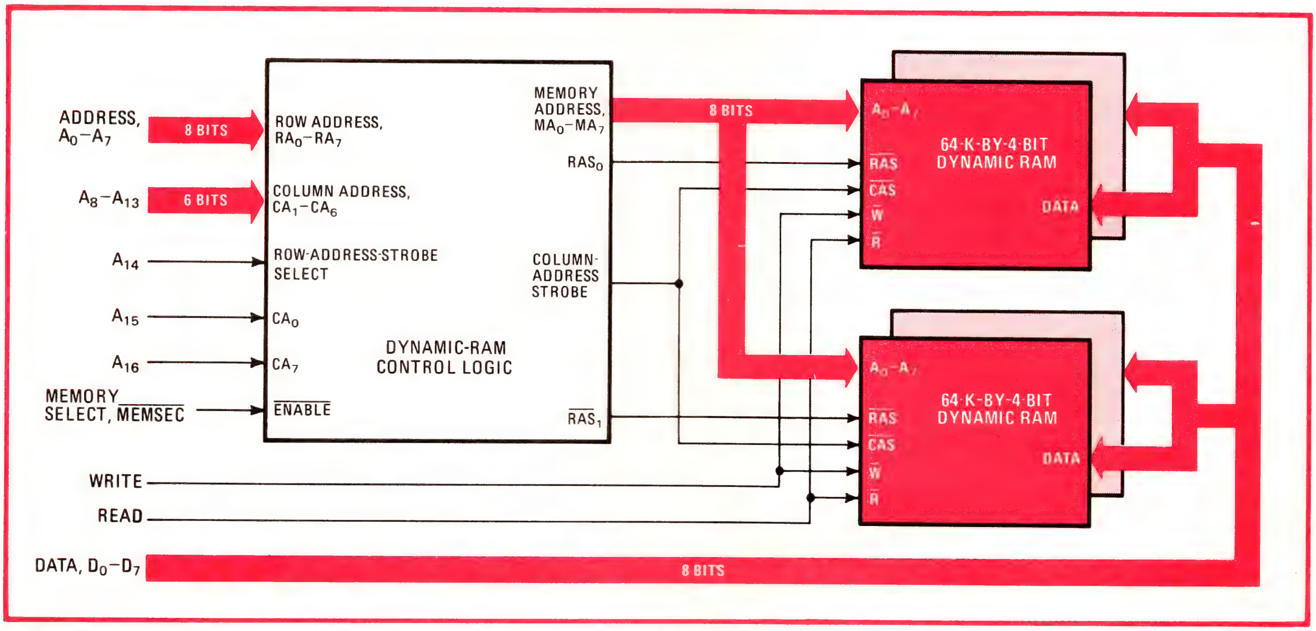
Other solutions to the data-rate problem have been offered lately, including continuous nibble, a hybrid of nibble and page mode. Using continuous-nibble mode, designers can rapidly access large amounts of data, but only serially. Another solution represented by multiport memory chips such as TI's TMS4161 adds an extra serial port that can be used to read an entire row of data serially at a very high data rate while simultaneously handling conventional cycles on the random-access port.

Another important issue in some systems is granularity, or the minimum step size (in bytes) by which the memory can be increased. For example, in a system that implements an 8-bit word using 64-K-by-4-bit dynamic RAMs, the minimum memory size of 64-K-bytes lies in only two chips (Fig. 1). Here, additional memory can be added in 64-K-byte increments. On the other hand, if this system used 256-K-by-1-bit memory chips, eight chips with a total capacity of 256-K-bytes would be the smallest system possible. Furthermore, additional memory would have to be added in 256-K-byte increments. Consequently, a requirement of fine granularity suggests that at the 256-K-bit density level, this system might be built instead using a single 32-K-by-8-bit chip—for a 32-K-byte granularity.

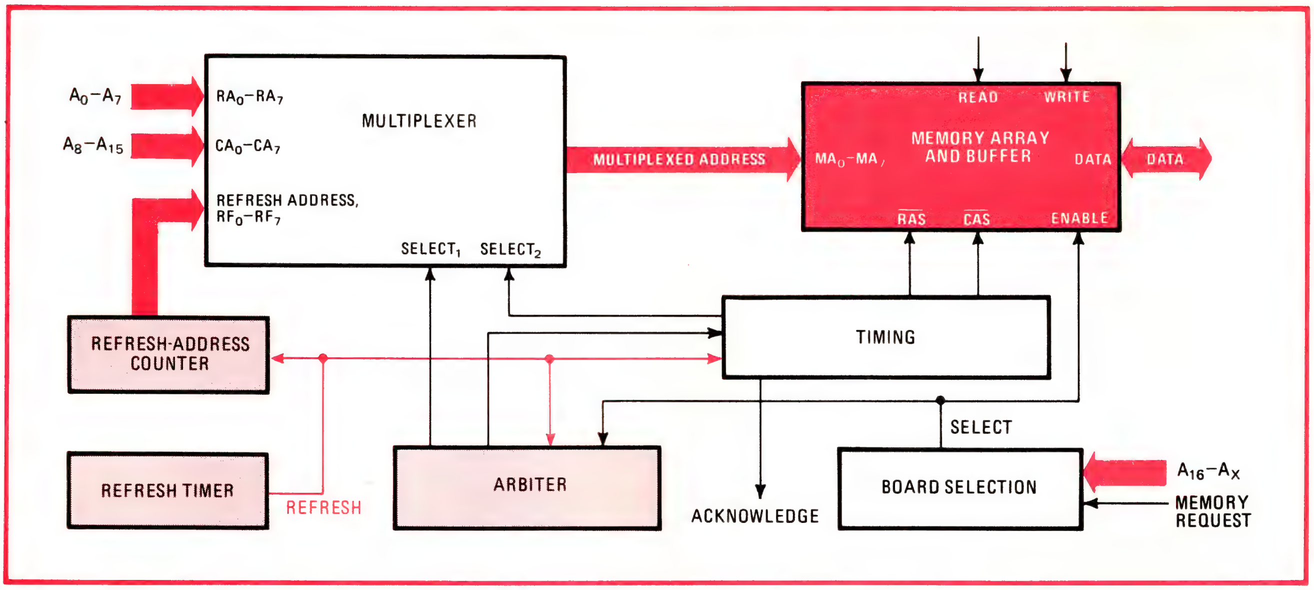
Refresh rivalry

Probably the most hotly debated issue in dynamic-RAM design is the choice of options for refresh control. Traditional manual refresh methods ensure that each row is either accessed within the refresh time or refreshed by means of RAS. A hidden-refresh mode, in which RAS can be toggled with CAS held low, has recently become popular. In this mode, the first RAS cycle reads memory, while subsequent row addresses refresh memory. The data read during the first row cycle remains valid during subsequent refresh cycles, effectively hiding these refresh cycles from the system.

However, all the refresh schemes mentioned above still require external hardware logic to generate refresh addresses and strobe signals (Fig. 2). In small systems, the cost of this hardware might be high enough to justify the use of static RAMs, even though their density is lower than that of dynamic RAMs. To prevent this situation, some or all of the required hardware can be included on chip. In the simplest case, an on-chip counter generates addresses for refresh. Nevertheless, external signals still



1. Good granularity. This memory subsystem needs a pair of 64-K-by-4-bit chips to implement 64-K bytes. Memory control logic splits a byte of data between two dynamic-RAM chips. When a processor needs to read a byte of data, the control logic combines them again.



2. Refresh logic. Systems based on dynamic RAM require dedicated hardware logic to handle memory refresh. Instead of using separate hardware (tinted area) to implement refresh circuitry, newer high-density memory chips should include this refresh circuitry on chip.

must prompt the chip to do a refresh.

Some manufacturers of 64-K chips use pin 1 for the refresh prompt. When a low pulse is applied to this pin, the chip automatically latches a refresh address into the row-address buffers, increments the internal address counter, and initiates a refresh cycle. Some versions include a timer on chip so that if pin 1 is held low for an extended period of time, the chip enters an extended refresh mode, in which on-chip circuitry periodically generates successive refresh addresses and automatically performs refresh cycles. Pin 1 refresh has its critics, however, particularly because this pin serves as the eighth address pin on 256-K dynamic RAMs.

An alternative to pin 1 refresh that is gaining popularity is called CAS-before-RAS refresh. All manufacturers specify that RAS go low before CAS for normal memory operation, leaving the opposite sequence available to indicate a refresh prompt. When the prompt occurs, a refresh address is loaded into the row-address buffers from an internal address counter, the address counter is incremented, and a refresh operation is performed. CAS-before-RAS refresh can be combined very neatly with hidden-refresh operation so that a board can refresh all its memory chips while maintaining its output.

But the most sophisticated refresh technique thus far is that of the pseudostatic RAM, which some vendors call integrated RAM. Such an IC includes all the dynamic-RAM refresh functions on chip, even while externally appearing as easy to use as a static RAM. Refresh operations are initiated internally whenever a timer deems it necessary—and a read signal informs the processor that the memory chip is busy. If the chip simultaneously receives an external memory request and an internal refresh request, on-chip circuitry arbitrates which request to service and which to queue. The memory's control circuitry informs the processor that the memory chip is busy. This combination of automatic-refresh features becomes especially attractive when implemented in an 8- or 9-bit-wide chip that also uses nonmultiplexed addressing. Such a chip can be used in a small system with little support circuitry.

The memory array's organization determines the IC's final appearance. Though there are as many choices for the architecture of a dynamic RAM as there are dynamic-RAM designs, most of the architectural decisions are driven by process technology and chip-size tradeoffs. Ideally, designers shoot for the lowest possible resistance in bit (column) lines and word (row) lines. In turn, the technology of this interconnection drives the choices for sense-amplifier placement and configuration, and decoder placement—factors that can have a tremendous effect on the chip's performance.

Refresh cycles

The minimum number of cycles in which the entire memory can be refreshed determines the number of internal rows and columns. For example, to refresh a 256-K memory in the nearly standard 256 cycles, 1-K must be refreshed during each cycle. This dictates that there must be 1,024 sense amplifiers (which implies 1,024 columns) and 256 word lines (which implies 256 rows). As a practical matter, however, the address space is square to minimize the number of address pins. That is, instead of having 10 address pins, only eight of which are used for the row and all of which are used for the column, there are only nine pins, all of which are used each time. The extra address entered with the row information is stored for use later with the rest of the column address.

Although the chip's external address space may be square (512 by 512 bits), its physical configuration is 256 by 1,024 bits. This lopsided internal-aspect ratio can mean very long word lines and concomitantly long internal propagation delays. Instead, the array may actually be broken up into sections so that the word lines in each section can be driven separately. This reduces the word-line delay time by a factor equal to the number of sections. Furthermore, the decoder can be shared by placing it between the two sections, a method that reduces the word-line delay without increasing power consumption, as would result if the row decoders needed to be duplicated. In a dynamic RAM, the bit lines—column lines connected to the capacitive storage cells—can be laid out in either a folded or an open configuration (Fig. 3). Two bit lines are always connected to a sense amplifier, and each can be connected to storage cells with transistors gated by the word lines. At any time, one bit line has selected a storage cell, and the other has selected a reference capacitor. In the open architecture, the bit lines extend physically from opposite sides of the sense amplifier, so that the two bit lines of a pair are in topologically different arrays. In the folded layout, the two bit lines are adjacent to each other in the same array on one side of the sense amplifier.

The primary advantage of the folded-bit-line approach is that the bit lines generally are subject to the same noise signals because they are adjacent. This results in improved noise immunity, thanks to the good common-mode signal rejection of the sense amplifiers.

The layout of a folded-bit-line array, however, is more complicated than that of the open-bit-line approach. In an open-bit-line array, a storage cell lies at each topological intersection of a word line and a bit line. In a folded-bit-line array, however, adjacent bit lines are hooked up to the same sense amplifier, so that each word line activates a cell on every other bit line only.

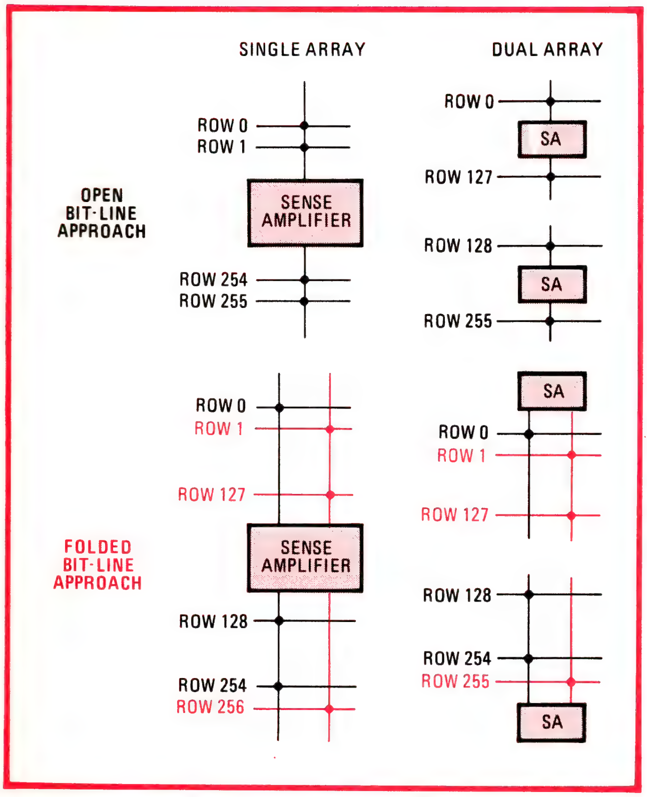
In a dynamic RAM, the selection of a storage cell results in a minuscule voltage change on a bit line from capacitive-charge sharing between the bit line and the storage cell. The sense amplifier must amplify this signal correctly to transmit and restore the data. The signal amplitude therefore is determined largely by the ratio of the bit-line capacitance to that of the storage cell. Thus the bit-line capacitance must be held as low as possible.

As memories become increasingly large, more cells connect onto each bit line, resulting in longer bit lines and correspondingly higher bit-line capacitances. One solution to this dilemma is to share one sense amplifier between two smaller bit-line pairs. By placing the sense amplifiers in the middle of the pair of folded bit lines and isolating the unselected half during amplification, the sensing margins can be effectively doubled. Nevertheless, this method does require a low-resistance bit line, such as one fabricated of aluminum, because the data must be propagated through the sense amplifier by means of the bit lines (unless a more complicated and costly double-level-metal process is used).

Potent processes

With memory densities increasing, manufacturing technology has had to keep pace to maintain a sharp performance edge for the new chips. By far the most evident performance parameter, and the one that can be most directly affected by processing technology, is memory speed. To increase speed, low-resistivity interconnections must be used throughout the chip.

At the 64-K density level, the interconnections of most ICs consist of one level of aluminum, two layers of conventional doped polysilicon, and one layer of diffused silicon in the substrate. In most cases, one of the polysilicon layers is used exclusively as the top plate of the storage cells in the array. The most popular architectures use either metal for the bit lines and polysilicon for the word lines, or metal for the word lines and diffusion for the bit lines. Each approach has advantages and disadvantages, but because both the diffusion and the polysilicon are relatively high-resistivity conductors, either the bit lines or the word lines suffer. The result is a long propagation-delay time on the affected signal lines.



3. Open-line configurations. Although open-bit-line configurations simplify layout, the folded-bit-line approach promises better noise immunity in dynamic RAMs. Sharing a sense amplifier in the dual-array design cuts the size of an open-bit-line dynamic RAM.

Because larger array sizes predominate at the 256-K level, these undesirable delays become intolerable performance limitations. The way out is to add one or two low-resistivity interconnections. One solution adds an extra layer of metal conductor such as aluminum or a refractory metal (tantalum, titanium, tungsten, or molybdenum). Alternatively, one of the two polysilicon interconnection layers might be replaced with a polyicide layer consisting of a sandwich structure of refractory metal and polysilicon. The advantage to this approach is that it not only reduces the conductor resistance by a factor of 10, but, since the material is predominantly polysilicon, this low-resistance conductor can also be used to build transistor gates. A third but less popular approach clads the diffusion layer with a refractory metal.

Most announced 256-K chips have thus far used folded-metal bit lines. The word lines generally consist of polyicide or conventional polysilicon stitched with a second layer of metal. The double-layer-metal approach results in the best possible performance, but significantly complicates the process and potentially reduces manufacturing yields. ☐

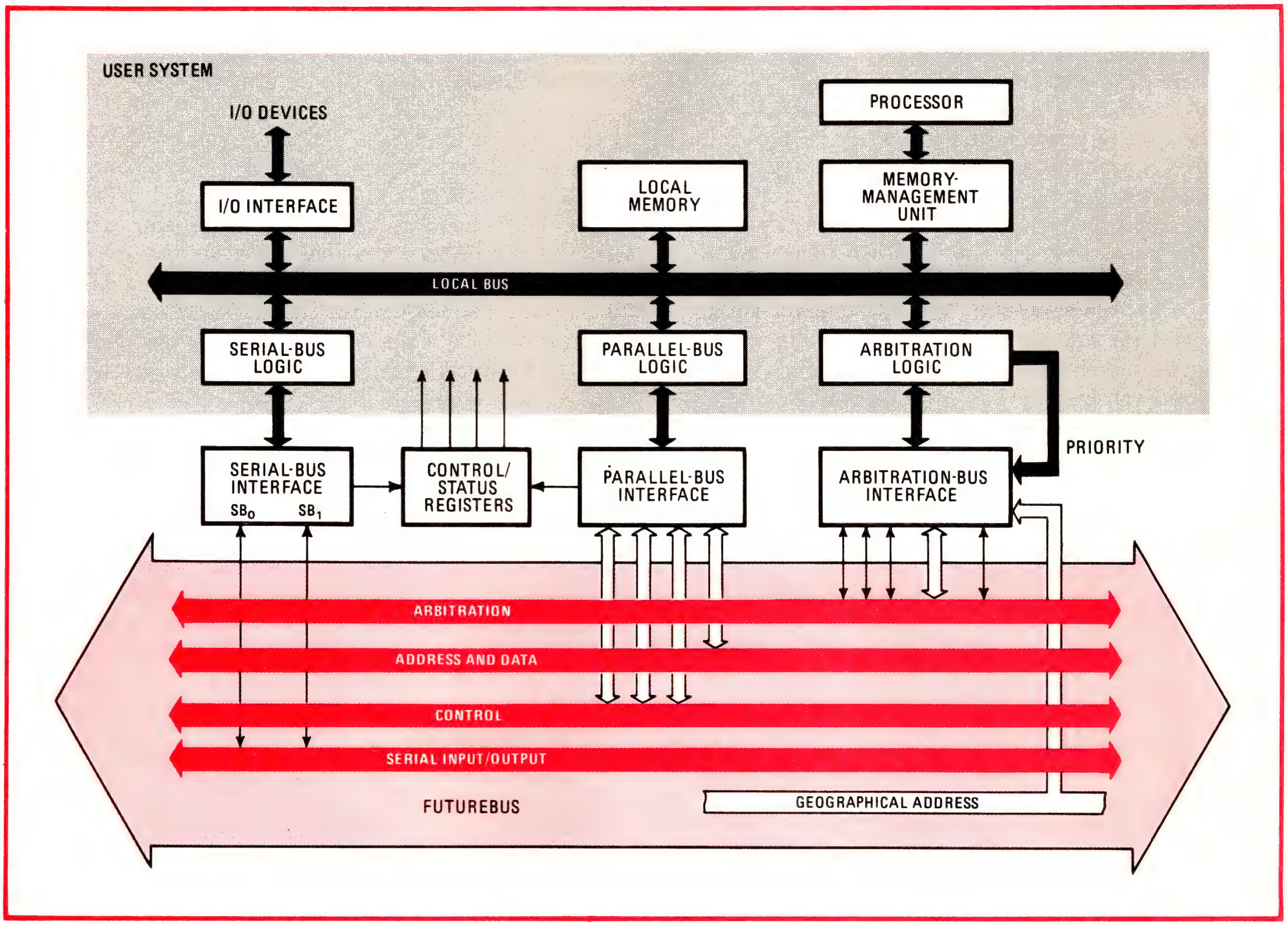
Futurebus anticipates coming needs

A new bus can reliably transmit 32 bits of data between bus modules at the very highest rate and use any foreseeable microprocessor architecture

by John Theus, *Tektronix Inc., Wilsonville, Ore.;* Matthew Taub, *IBM Corp., United Kingdom Laboratories, Hursley Park, England;* and R. V. Balakrishnan, *National Semiconductor Corp., Santa Clara, Calif.*

☐ When the Institute of Electrical and Electronics Engineers told working group 896 to devise an advanced 32-bit backplane bus, the Futurebus committee (as it later came to be called) had to develop a parallel protocol that could reliably transmit 32 bits of data between two or more bus modules at the highest possible rate, use any foreseeable microprocessor architecture, and provide the "hooks" needed for multiprocessor operation. To achieve all this, the committee chose an asynchronous protocol in which 32 bits of addresses and data are multiplexed on a common set of lines, and data transfers have been optimized for 32-bit words. Other important features of the protocol include support for 8-, 16-, and 24-bit data transfers, interlocked operations, broadcast transfers, and a block-transfer mode. Protocol hooks have been left for future expansion.

Probably the most visible difference between Futurebus (Fig. 1) and the other recently announced 32-bit buses [*Electronics,* March 22, 1984, p. 124] is its asynchronous protocol. Because such protocols are often poorly specified and difficult to understand, they are typically viewed as inferior to synchronous protocols. In fact, however, a



1. Interface. Modules are connected to Futurebus through the parallel-bus, the arbitration-bus, and the serial-bus interfaces. Moreover, the electrical interface provides major improvements over previous technologies that are based on TTL.

properly defined and correctly applied asynchronous protocol is actually a superior general backplane bus.

For instance, with an asynchronous protocol, the bus is not constrained by a system clock, so the system's speed is not fixed at the maximum level set by today's technology. This means that bus modules—the collection of hardware performing as a single functional entity—that have been designed with today's technology will work in tomorrow's faster systems. The older technology module will slow a transfer only when it is actually participating in operations. Even then, it will still work.

Another advantage of asynchronous protocols is the lack of centralized bus elements, for no clocks, logic blocks, or system circuit boards need accompany a Futurebus backplane. Futurebus systems are built on backplanes with no parts except connectors and termination resistors. There are no special circuit-board slots into which certain boards must be plugged and no special rules about laying out the backplane to keep the clock skew under control.

With the decentralized architecture of an asynchronous protocol, the bus is more reliable, since there are no central control components to fail and bring the bus down. Furthermore, a failed module can be isolated from the rest of the system, thereby permitting performance to degrade gracefully. System expansion is simpler, too, since there are no rules about bus length or board ordering as long as the maximum bus-propagation delay is not exceeded. Small backplanes can just be plugged together to form a larger backplane, without any need to worry about radial signal connections or keeping the clock source in the middle of the backplane.

Fastbus model

Creating a good protocol was a major task, and the Futurebus committee went through several designs and prototypes before settling on a protocol that is a variation on the parallel protocol used by Fastbus, which was designed by the U. S. NIM Committee for the high-energy physics community. The Futurebus parallel protocol has two data-transfer modes. The single-transfer mode is optimized for flexibility, the block-transfer mode for speed. Both use the same set of signals on the backplane. The four primary signals are address strobe (AS), address acknowledge (AK), data strobe (DS), and data acknowledge (DK).

The current bus master chooses the operating mode, which is then transmitted to the slave through a 5-bit command code sent on each address and data cycle. Whatever code is sent during an address cycle selects the protocol mode—for instance, whether the transaction is to be a single or a block transfer. Whatever code is sent during a data cycle selects the direction of data flow between master and slave, as well as which of the 4 bytes in a 32-bit word is to be accessed.

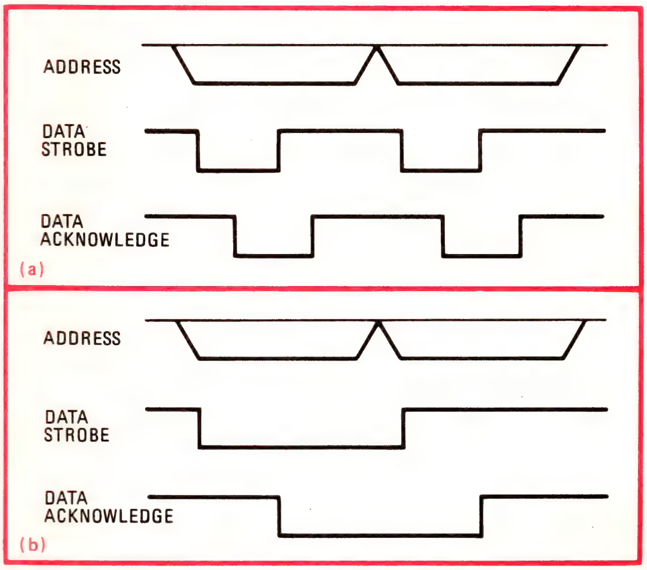
Both modes begin when the current bus master initiates an address cycle by placing address and command information on the bus. An AS follows this information. When the master asserts the AS signal, the master guarantees that the strobe will not reach any slave before the address does, because it takes into account its own logic skews and the maximum signal skew on the bus. The slave provides the logic needed to account for its own internal skews and then checks to see if it recognizes the address. If it does, it responds with a status code that tells the master about its condition and follows this code by the assertion of address acknowledge, signifying that a connection has been made between a master and one or more slaves.

Of the two methods of data transfer, the single-transfer mode uses a four-edged handshake (Fig. 2a), where both the rising and falling edges of DS and DK control the transfer. This mode lets the master string read and write cycles to a single slave address. The block-transfer mode uses a two-edged handshake (Fig. 2b), where a set of DS and DK edge transitions control a data transfer. In this mode, the master sends the slave a starting address for the data, and from then on, the slave increments the data's address internally.

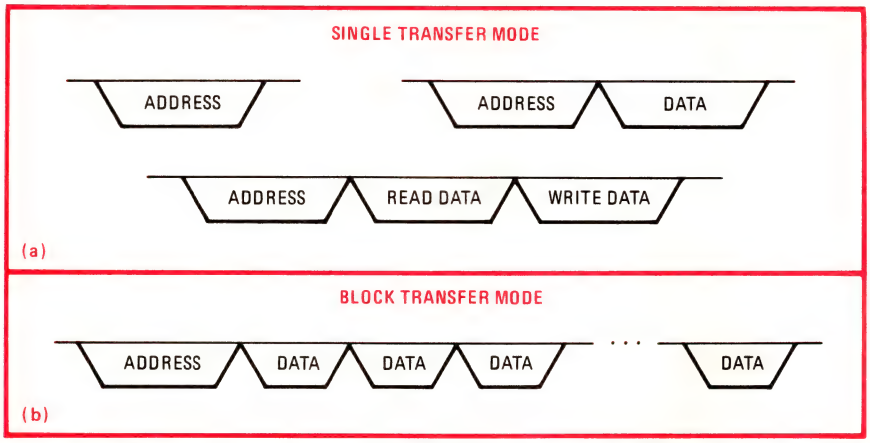
The two forms of data transfer can be used to create primitives to fit specific applications. In the single-transfer mode (Fig. 3a), a master can create read-modify-write or read-after-write cycles. During block transfers (Fig. 3b), data flows in one direction only; the master is either reading or writing a block. No present-day asynchronous handshake is more efficient and imposes fewer bus delays than the two-edged protocol does. With today's technology, transfer rates of 40 megabytes a second are achievable, and transfer rates of 60 megabytes/s will soon be possible as well.

Using the broadcast mode, a master can talk to several slaves simultaneously. Data can be written to or read from all slaves at the same time and therefore reaches the master logically ORed together. To this end, the handshake signal set is increased from four signals to six, to accommodate both fast and slow slaves. With the two extra handshake signals, the broadcast data-transfer speed is always controlled by the slowest module that is participating in the transfer.

Once the handshake protocol is complete, the next



2. Two handshakes. The traditional four-edged handshake (a) allows data flow to change direction every cycle. With the two-edged handshake (b), data can flow in only one direction, which greatly reduces the delays associated with data transfers.



3. Transfer modes. From the set of data-movement primitives, transfer sequences can be built for an application as in (a), where single transfers yield random read/writes to a single address, and (b), where a block transfer moves a chunk of data to an incrementing address.

problem is where to place a byte of data on the 32 data lines. Most currently announced 32-bit microprocessors can generate 8-, 16-, 24-, and 32-bit data cycles, but some make 32-bit data references on byte-address boundaries. Some vendors use Little Endian byte ordering—as, for example, when the least significant byte occupies data bits 0 through 7, while others use Big Endian byte ordering, where the most significant byte occupies data bits 0 through 7. All this makes it almost impossible to give the bus a byte-ordering scheme that does not preclude the use of at least one type of 32-bit microprocessor.

Futurebus distinguishes itself from the pack by not defining the byte ordering on the bus. Instead, users build modules using the byte ordering that is appropriate for the microprocessor. Data written to the bus by the processor will be read back correctly to that processor, no matter what address mode or data type may be used. Problems occur only when processors with opposite byte ordering want to communicate with each other. In this case, the specification recommends that the modules format their interprocessor communication messages by using the Little Endian format.

Optimized for 32 bits

The decision to go with nonjustified data placement was easy to make. Most 32-bit buses justify their data transfers to make 16-bit processors simpler to connect, but this procedure makes 32-bit transfers more difficult. On a totally justified bus, 8 lines are used to transfer each of the 4 bytes of a 32-bit word during byte transfers, and 16 lines are used to transfer both halves of a 32-bit word during 16-bit transfers. With this type of justification, both 8- and 16-bit processors connect directly to the bus, without help from byte-switching hardware. But 32-bit processors and all 32-bit memory systems must have such hardware.

On a partially justified bus, the 16-bit connection is identical, but the 8-bit path is byte-switched onto its 16-bit counterpart. With this system, a user of a particular 16-bit microprocessor can connect to the bus without byte switches, but all 8- and 32-bit processors and all 32-bit memory systems must have switches.

Futurebus uses a nonjustified data path to eliminate the need for byte switches. A 32-bit processor with a nonaligned bus interface needs no switching hardware; all other types of processors need some form of byte switching. A 32-bit memory module does not have byte switches. The combination of nonjustified data and four individual byte-enable signals makes it possible to transfer any combination of the four possible bytes during a single transfer.

Associated with each of the four byte paths is an odd parity bit. Since the specification requires no parity checking, users can trade error detection for speed. Besides the 32-bit data bus, the 5-bit command code has its own parity bit. A dedicated bus signal indicates, on a cycle-by-cycle basis, if the parity contains valid information.

A bus designed for multiprocessing with multiple processors needs a locking mechanism, so that indivisible bus transactions are sure to be mutually exclusive. In the simplest form of the locking procedure, a processor might execute a test-and-set instruction that results in a read-modify-write bus operation. The interlock protocol ensures that no other device can perform an operation between the read and write cycles.

Resource gathering is a more complex use of the interlock protocol. A process running on a processor may simultaneously need the resources of several slave modules. The processor can acquire each slave using the interlock protocol and prevent other processors from gaining access until the job is done.

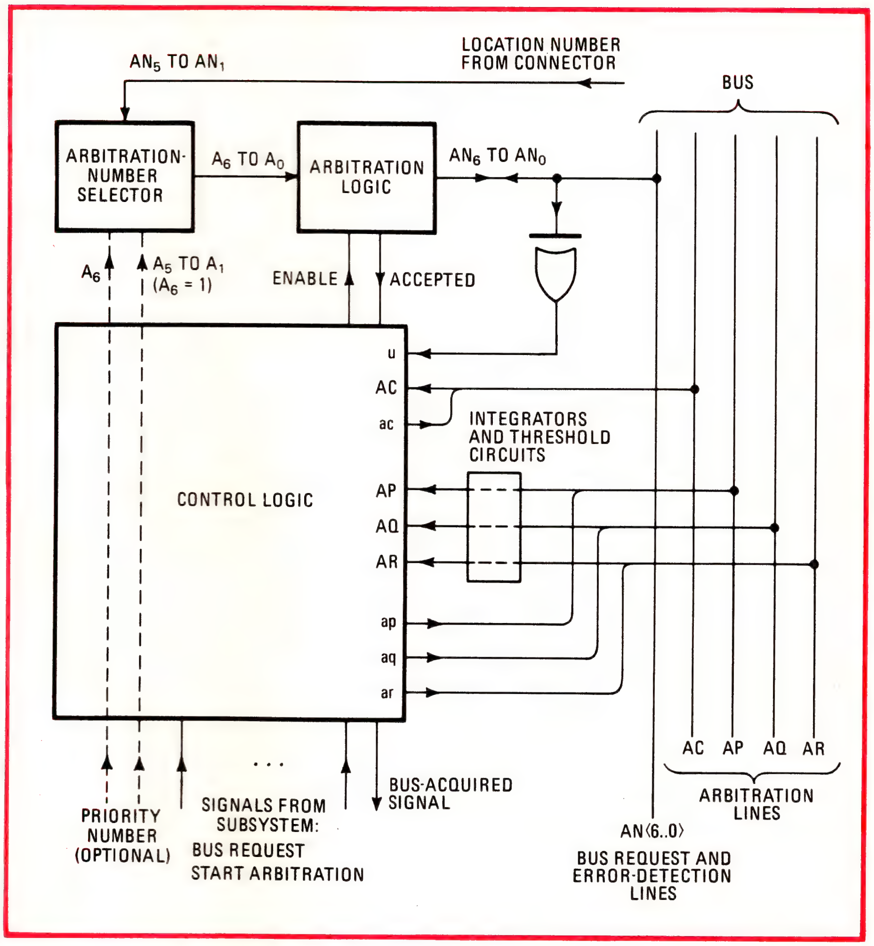
Arbitration process

To use these data-transfer protocols, a module must first arbitrate with all the other modules that may want access. It is the arbitration process that determines what module will get control of the parallel bus. Devising the arbitration scheme for Futurebus was particularly difficult, since the protocol must operate without central control elements, use only a limited number of bus signals, work reasonably quickly and reliably, and be independent of logic chips of any particular speed. Since the arbitration protocol must handle simultaneous requests reliably, many of the arbitration circuits that are now in production are not suitable, because they permit an occasional metastable fault, which can cause multiple masters to collide on a bus.

The Futurebus arbitration system (Fig. 4) consists of control- and arbitration-logic sections, each residing on every module that is a potential bus master. Arbitration logic makes the logic calculation that determines which module will be the next bus master.

The basic arbitration mechanism is the same one found in two other buses: the IEEE S-100 bus and Fastbus. Every potential master is allocated a unique 6-bit arbitration number. Through open-collector drivers, competing potential masters apply the digits of their 6-bit arbitration number and an optional parity bit onto the bus. The

4. Arbitration. Arbitration logic resides on every module that is a potential bus master. The number-selector block choses either the modules' geographical address or a software-supplied priority number to determine priority.



odd parity digit is applied at the arbitration number's least significant bit, so the odd parity digit has no effect on the actual arbitration process.

At any moment, the digit on an arbitration line will be the OR function of the digits applied to that line by all the competitors. The arbitration logic (Fig. 5) in each potential master is arranged so that if it is applying 0 to a particular line but detects that the line is carrying a 1 applied by a competitor, it ceases to apply all the digits of lower significance. As a result, when the whole system has settled, the arbitration lines will carry the highest arbitration number among the competitors. The module that is still applying all its arbitration digits and detects that the number on the arbitration lines agrees with its own will recognize that it has won.

If the arbitration scheme were to be used in exactly this way, modules with low arbitration numbers would be at a disadvantage because under heavy traffic, they could be kept off the bus. To preclude this possibility, Futurebus adopted a fairness scheme: when a module has finished using the bus, it refrains from issuing any further bus requests until all others have been filled.

Fairness has its limits, however. Potential masters fall into either of two classes: fairness modules, which operate according to this scheme, and priority modules, which compete for the bus when they need it. Modules in the priority class always have higher arbitration numbers than those in the fairness class, so when members of both are competing against each other, the priority module always wins.

The main difference between the arbitration scheme of Futurebus and those of its predecessors is a fully distributed control system, which decreases the chance that a single failure might put the bus out of service. Usually, the arbitration process is initiated by the potential master currently in control: the current master. In some circumstances, there is no current master and any potential master can initiate the arbitration process.

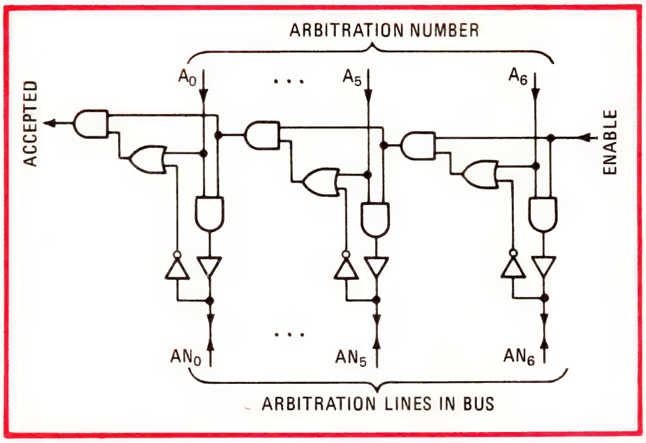
The current master does not have to wait until it has finished with the bus to initiate arbitration; it can do so at any time, so arbitration and data transfer can take place concurrently. Ideally, a current master would initiate arbitration shortly before completing a data transaction, so that as soon as it was over, the current master would pass control to a successor.

Since the arbitration logic is distributed across all the potential masters on the bus, a way of synchronizing all the distributed logic had to be devised. The resulting technique, for which a patent is pending, uses three wired-OR lines—AP, AQ, and AR—to control a three-state circular state machine. A fourth wired-OR line, AC, controls two functions: during one phase of the control sequence, modules use it to signal a bus request; during another phase, it sends a signal that an error condition has been detected.

The bus's three control signals and the wired-OR characteristics control the transition from state to state. No module can enter a new state until the slowest module on the bus is ready to make that transition—an event signaled when one of the three control lines changes from a binary 1 to a 0, making it possible to define three basic states. The protocol uses two passes, or six states, to determine the next master and to pass control to it.

Using wired-OR lines in this way creates a problem. If two or more devices hold a line at a binary 1 and one switches to 0, the line's redistributed current generates a spurious pulse, or glitch. Unless precautions are taken, it can cause the line's state to be misinterpreted. These glitches' effects can be overcome by the inclusion of an integrator and threshold circuit in each receiver connected to the AP, AQ, and AR lines. Such circuits are designed so that the longest possible glitch or succession of glitches will not cause the circuit's output to switch.

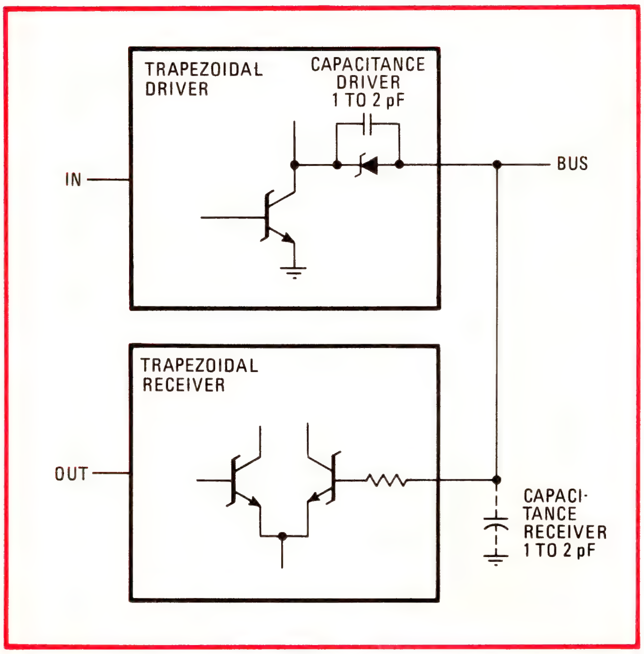
Bus loading and the speed of the logic on the partici-



5. Arbitration logic. The 6-bit arbitration number plus a parity bit are placed on the bus through open-collector drivers. If on any digit, the logic detects a binary 1 when it is supplying a 0, it removes all its digits of lower significance. After transitions have settled, only the highest arbitration number remains.

pating boards cause the arbitration settling time that these circuits enforce to vary. When a module reaches the protocol state that performs the arbitration, it waits at least as long as the worst-case settling time calculated for its own logic delays and the worst-case bus propagation delay. The control protocol then prevents the transition to the next state until the slowest module has reached its time delay. All modules are thus guaranteed to sample arbitration lines only after they have settled.

The greatest delays in the arbitration process are associated with today's logic speeds and the time required for settling, but as logic delays decrease, the bus-propagation delay will become the significant factor. It was therefore very important to make sure that the electrical specification would keep the maximum bus propagation delay as short as possible, both for the arbitration and for the parallel protocols.



6. Transceiver. The capacitive isolation, lower output swing, and trapezoidal noise reduction of the Futurebus transceiver offer a unique solution to the bus-driving problem.

One of the major performance features of Futurebus is its special transceiver, designed by National Semiconductor Corp., Santa Clara, Calif., [*Electronics*, Dec. 15, 1983, p. 86]. This transceiver overcomes fundamental problems associated with driving densely populated backplanes and significantly improves speed and data integrity. Although the committee did not want to require nonstandard interfaces in the bus standard, the severity of the problem demanded this drastic step.

The basic problem is that standard TTL transceivers cannot drive heavily loaded buses properly and cause too much noise because of fast signal transitions. In general, the resulting reflections and crosstalk require several bus round-trip delays to settle, forcing users to accept long bus delays to maintain the integrity of transferred signals. Such a high-performance bus as Futurebus cannot tolerate that loss in bus throughput.

Futurebus gets at the root of the problem by attacking the transceiver's large output capacitance (Fig. 6). The addition of a Schottky diode that is in series with an open-collector driver output isolates the drive transistor's capacitance with the small reverse-biased capacitance of the diode in the nontransmitting state. Typically, the capacitance of the Schottky diode is less than 2 picofarads and relatively independent of the drive current. Allowing for a receiver input capacitance of an additional 2 pF, the Futurebus transceiver's total loading can be kept below 5 pF. Futurebus specifies a maximum plug-in card capacitance of 10 pF to accommodate 5 pF of trace and connector capacitances.

Besides reducing the loading on the bus, the transceiver keeps power down by reducing the voltage swing on the bus to about 1 volt. Contrary to common belief, the lower swing does not reduce immunity to crosstalk as long as the receiver threshold is tightly controlled, because the induced crosstalk from other bus lines scales down with the amplitude of the signal causing it. With a precision receiver threshold, the noise margin (expressed as a percentage of signal amplitude) remains the same, and so does crosstalk immunity.

However, the absolute noise margin—brought about partly by a noise source external to the bus—does shrink in a linear manner with amplitude. Fortunately, the low impedance and the short length of the bus make this component insignificant in high-speed backplanes. Nevertheless, the backplane should be shielded from strong noise sources external to the bus.

The Futurebus transceiver has a precision receiver threshold centered between the low and high bus levels of 1 and 2 V, respectively. Confined to a narrow region of ±3% (±50 millivolts), the threshold tracks the bus in a high-level manner to provide a maximum percentage noise margin with respect to the bus's low and high levels. In addition, the driver features a trapezoidal output waveform with a 6-nanosecond transition time to reduce crosstalk, and the receiver incorporates a noise filter that selectively rejects crosstalk noise pulses up to 8 ns in pulse width. These techniques virtually eliminate crosstalk, thereby increasing system reliability by several orders of magnitude. □

Active-matrix addressing enhances flat panels

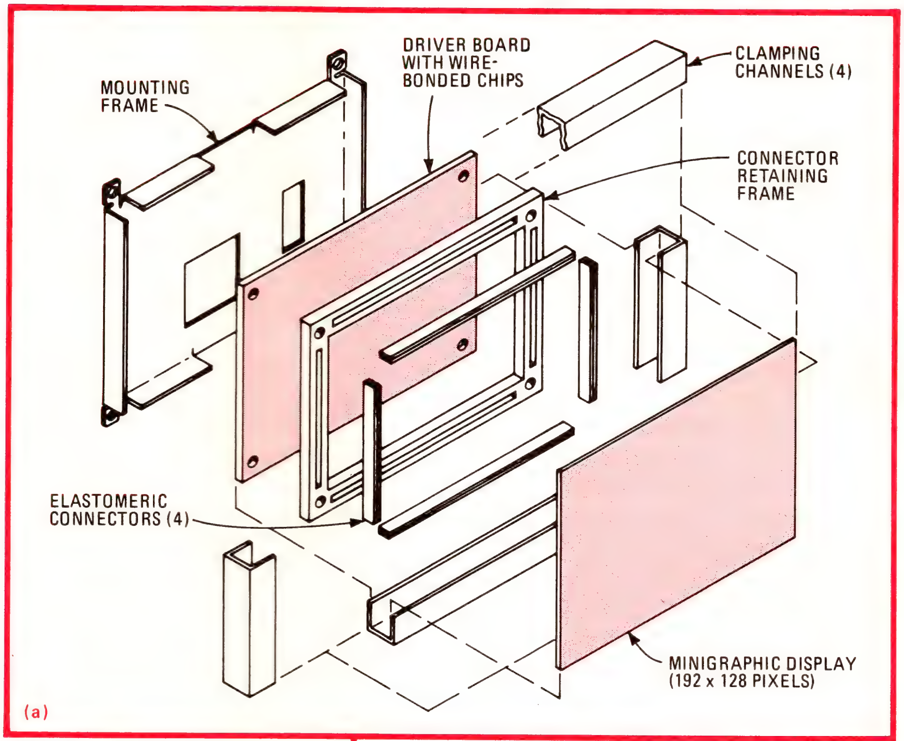
Thin-film-transistor matrices realize denser integration in liquid-crystal displays

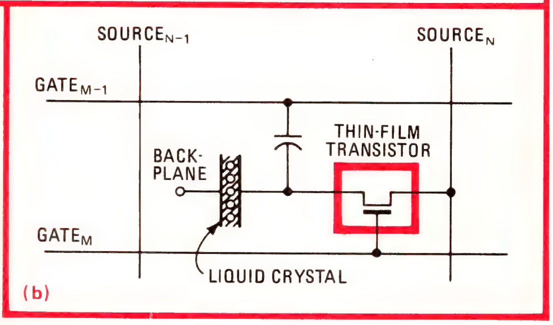
by Peter Brody, Fang-Chen Luo, and Paul Malmberg, *PanelVision Corp., Pittsburgh, Pa.*

☐ The most significant progress in semiconductor electronics up to now has been in the areas of miniaturization and integration. Displays, on the other hand, cannot be miniaturized or they cease to be useful. Yet a display and an integrated memory chip have a lot in common: a picture element is essentially a bit made visible. While technological advances in memory chips have taken place, however, displays have not undergone a similar evolution.

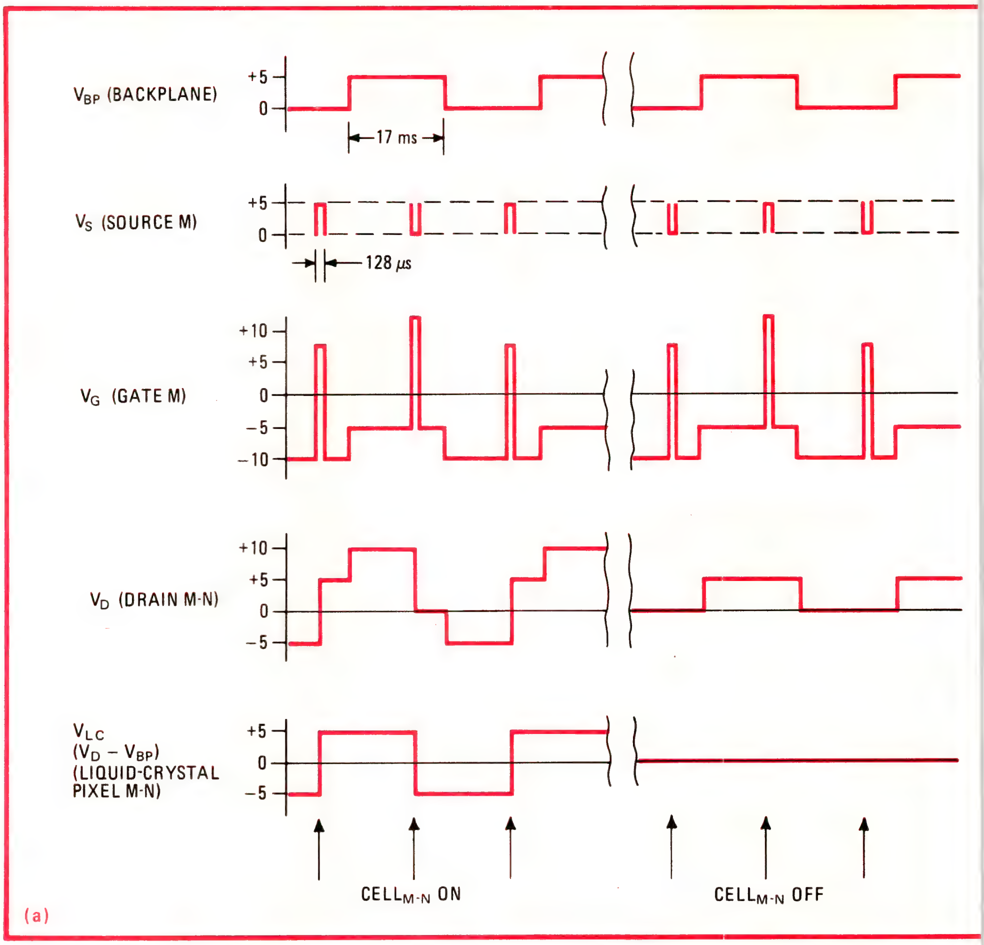
The reason is that most past efforts in flat-panel displays have concentrated on the technological potential of optoelectronic materials but not on how to address them. A great diversity of materials such as light-emitting diodes, phosphors, liquid crystals, ac and dc plasma discharges, electrochromics, electrophoretics, and other exotic substances have been tried, but addressing and interconnecting them always came in as an afterthought.

With the proliferation of large-area liquid-crystal displays, the need for an improved addressing technique continues to grow. Multiplexing techniques, though highly developed, have limited use in high-information-content displays. In their favor, highly multiplexed, twisted-nematic displays are flat, lightweight, use less power, and are inexpensive. But they have drawbacks, which include limited resolution, narrow field of view, poor contrast, slow response, limited temperature range, and an absence


MOUNTING FRAME
DRIVER BOARD WITH WIRE-BONDED CHIPS
CLAMPING CHANNELS (4)
CONNECTOR RETAINING FRAME
ELASTOMERIC CONNECTORS (4)
MINIGRAPHIC DISPLAY (192 x 128 PIXELS)
(a)



1. MiniGraphic. PanelVision's MiniGraphic liquid-crystal display uses thin-film-transistor matrices to drive 24,576 picture elements, arranged as 192 columns by 128 rows (a). The active-matrix circuit is formed on a thin glass substrate. Each TFT cell (b) is then iterated to form the active matrix.



2. Driving waveforms. When V_{bp} changes, there is no change at all in the potential across the pixels except at the write times that have been assigned (a). The driving waveforms (b) are furnished by the shift registers.

of gray scale, video, and color capability. As applied to liquid crystals, the direct addressing of each pixel through an associated thin-film transistor eliminates the problems currently associated with multiplexed LCDs (see "Active-matrix addressing versus multiplexing," p. 116).

Beginning in the early 1970s, efforts at Westinghouse Research and Development Center, in Pittsburgh, Pa., were directed at the problem of addressing and integration, independent of materials. The company postulated a large, memory-like integrated circuit, blown up to the size of the display itself, and called it an active matrix to distinguish it from the traditional passive matrix addressing of flat panels. In addition, it was decided that circuits that were intended to measure 6 to 12 inches on a side would probably be very difficult to fabricate on single-crystal silicon, and so attention was turned to the polycrystalline TFT for a solution.

By fabricating the TFT on the display substrate, on which a diode or transistor can be placed in series with each pixel, multiplexing no longer remains an issue. The active matrix performs the tasks of addressing, switching, multiplexing, and providing local memory, thereby relieving the display material of these duties, which it usually performs poorly if at all. It also allows power to be fed continuously to the pixels instead of in short spurts, as is the case for all passive-matrix-addressed displays as well as for the cathode-ray tube.

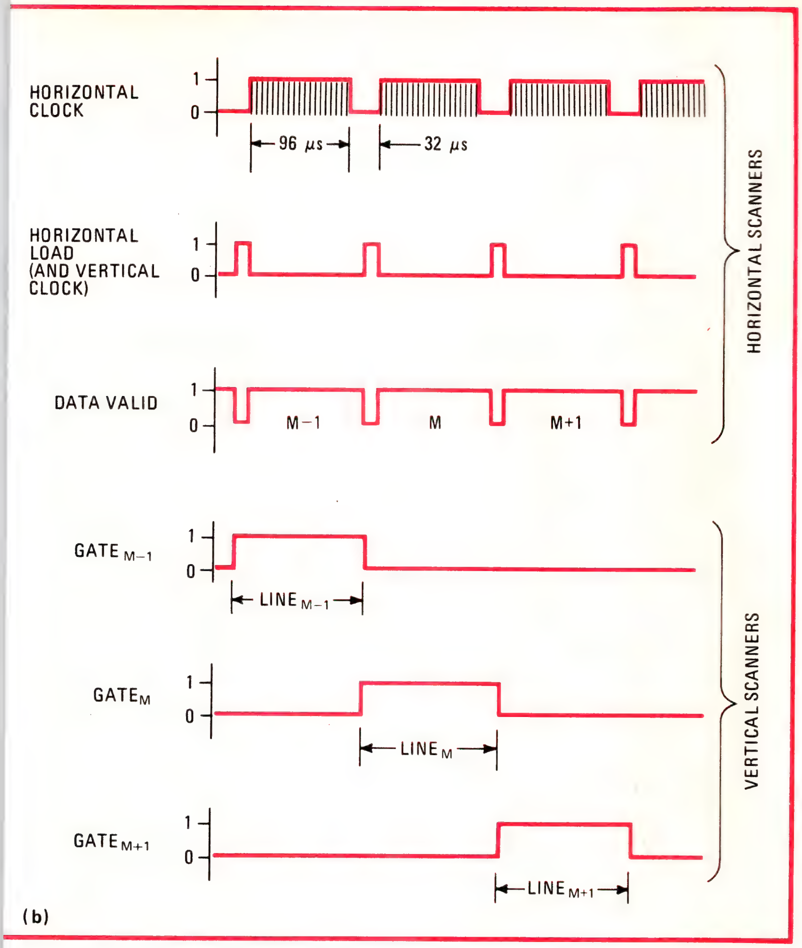
Based on the initial work at Westinghouse, the first large-area, high-resolution (12,000 pixels) LCD was reported in 1972. A TFT-addressed electroluminescent television display followed in 1975, and a projection liquid-crystal television unit in 1978. PanelVision was formed late in 1980 as a spin-off from Westinghouse and is currently concentrating on applying active-matrix integration to LCDs.

The other major development effort currently under way on active matrix displays is taking place in Japan. The Japanese prefer to use amorphous or polycrystalline silicon TFTs, while PanelVision favors cadmium selenide because it has higher carrier mobility than silicon films and is better suited to the construction of high-frequency devices, which are needed for the column drivers of a fully integrated display. Much of the cost of the current generation of flat-panel displays is in the driver electronics and its assembly and attachment to the panel.

Four components

The PanelVision display uses a standard field-effect liquid-crystal material operating in the twisted-nematic mode. It consists of four components: the active matrix circuit, formed on a thin glass plate; a liquid-crystal layer; an indium tin oxide counterelectrode; and a (currently) separate driver board (Fig. 1a). This display, called the MiniGraphic, comprises an array of 128 rows by 192 columns, with each pixel addressed individually by a TFT (Fig. 1b). The TFT gates in all cells of a particular row are connected to a common horizontal gate bus, while the TFT sources in all cells of each column are connected to a common vertical source or data bus. Each cell has a storage capacitor that maintains a constant voltage on the liquid-crystal element between successive addressing cycles.

By holding a gate bus at a positive potential relative to the source potential during the address interval for the corresponding line, the TFTs in that line are switched on. The data-signal voltages on the source buses are at this time transferred to the output electrodes and storage capacitors, and remain there until the next address cycle for that line in the succeeding frame. Cell capacitance is approximately 10 picofarads, corresponding to a capaci-



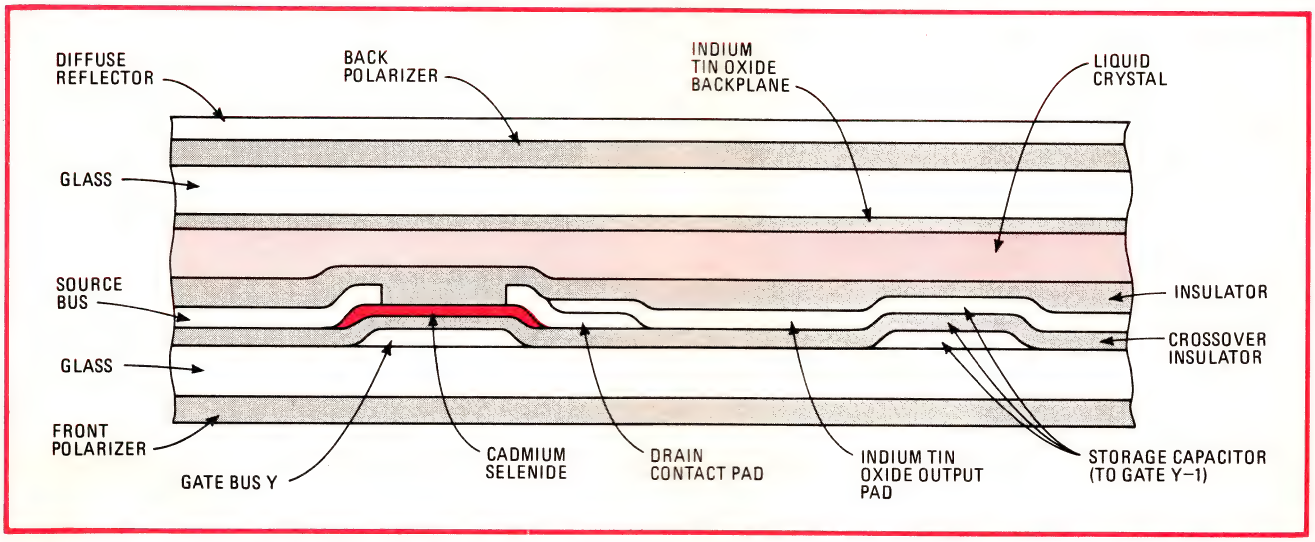
tor area of about 60 square mils. The panel operates at a 60-hertz frame rate, which corresponds to a 7.8-kilohertz line rate (128-microsecond line-address time). Data signals impressed on the source buses of the display are 0 or +5 volts, as is the backplane (counter electrode) potential. Liquid-crystal polarity is reversed in each frame by inverting both backplane and data polarity.

A major saving in cell complexity and reduction in light-blocking structure is obtained in the cell geometry by connecting the storage capacitor's return electrode to an adjacent gate bus instead of to a separate return bus. Thus while a given line is being written by a positive pulse on its gate bus, the next previous gate bus—to which these capacitors all return—must be held securely at the negative gate potential, or vertical negative rail, V_{ss}. This arrangement requires slaving the gate-driver supply rails, V_{dd} and V_{ss}, to the square-wave backplane drive, V_{bp}, so that when on successive frames V_{bp} changes from 0 V to +5 V (or from +5 V to 0 V) no change in potential occurs across the liquid-crystal elements in a given row, except at assigned write times (Fig. 2a).

With a cell capacitance of 10 pF and a voltage change for on cells of $\Delta V = 10$ V, the minimum (average) on current of the TFT switch during line address/write (that is, positive gate pulse) is approximately 1 microampere. Because of the changing voltage on the capacitor—and hence on the TFT—during charging, the initial peak current must be larger to give this average value for the on current. The worst case occurs when the capacitor is charged from a more negative to a more positive value, the TFT then acting as a source follower.

Panel assembly

In the off condition, the maximum allowable source-and-drain current is determined by the amount of voltage change, or droop, permissible in the liquid-crystal element between successive address/write cycles. Since the write cycle charges the cell and liquid-crystal capacitors of an on cell to a full 5 V while the liquid crystal is nearly saturated at 4 V, a droop of approximately 1 V can be tolerated in one frame time (17 milliseconds) without significant optical degradation, cor-



3. Panel construction. The PanelVision active-matrix panel is constructed in one of various possible combinations. First the gate bus is delineated, followed by the crossover insulation, source bus and drain-contact pads, thin-film transistors, and indium tin oxide outputs.

Active-matrix addressing versus multiplexing

Time-division multiplexing has so far been used successfully to extend the vertical resolution of liquid-crystal displays. This technique, however, is not only beginning to reach its limits of usefulness but also is presenting significant compromises in performance.

The problems of multiplexing through passive XY addressing can be illustrated with a single XY-addressed liquid-crystal element. In order to turn it on, the sum of the voltages on its row and column electrodes must exceed its turn-on-voltage threshold, V_{th}. If the other elements common to the same row and column are to remain off, the voltages across these elements must stay below V_{th}. However, liquid crystals are sluggish and exhibit a time-integrated root-mean-square voltage response rather than an instantaneous response. The off elements see the integral of all the column voltages, and as the number of rows (N) is increased, they will tend to turn on. It can be shown that, in consequence, the permissible rms on-voltages can only barely exceed V_{th}, while the off-voltages can only be marginally below it. As an example, for $N = 100$, and with the best possible voltage division between rows and columns, the voltages are $V_{on}=1.048\ V_{th}$ and $V_{off}=0.949\ V_{th}$.

Since for good contrast and viewing angle, V_{on} should be at least 2 to 3 times V_{th}, the multiplexing process seriously degrades performance in these respects. In addition, it demands great accuracy on the drive waveforms as well as cell spacing.

In terms of the "sharpness" parameter $p=\Delta/V_{th}$, where Δ equals the voltage width of transition between off and on, the maximum number of multiplexible lines is given as $N_{max}=((1+p)^2+1)^2/((1+p)^2-1)^2$. Typically, p ranges between 0.15 and 0.5, yielding $N_{max}=52$ for $p=0.15$ and 7 for $p=0.5$.

There are other problems as well. It can be shown that the required supply voltages go up proportionately with the square root of N. For example, with $N=100$, about 25 volts are needed. In addition, the speed of response of the liquid-crystal material is proportional to $(V_{on}/V_{th})^2-1$, and since V_{on} is barely greater than V_{th}, the response is very slow and gets slower with increasing N.

A further complication arises because V_{th} is temperature-dependent, and, since operating margins are so small, accurate temperature compensation is required for V_{on} and V_{off}. This adds to the complexity and cost of the panel. Variations of the on and off waveform amplitude also reduce the value of N_{max}, so for higher N increasingly stringent control of the waveforms is needed. Further, V_{th} is a function of the thickness of the liquid-crystal layer, and hence the cell spacing also has to be very accurately controlled.

Clearly, all the difficulties increase as N increases, while at the same time the visual performance deteriorates. Gray scale, video, and color are unattainable with multiplexing. Also, multiplexed displays require separately mounted integrated circuits for their row and column drivers, while the thin-film-transistor technology underlying the active matrix allows the full integration of row and column drivers, reducing cost and adding reliability. Finally, active-matrix addressing can drive otherwise nonmultiplexible materials that have better visual properties than liquid crystals.

responding to a maximum TFT off (or leakage) current of about 0.5 nanoampere with a worst-case source-drain voltage V_{ds} of 10 V. For a typical TFT as used on the panel, a 5-V gate swing covers this range of on/off current. An additional 10-V swing is needed to encompass the data (source) voltage range of 0 to +5 V, plus the V_{bp}/V_{ss} voltage shifts between 0 and +5 V. The drive circuit for the present panel provides an 18-V gate pulse, thereby covering the required 15-V range with an acceptable margin.

Horizontal and vertical scanners comprising complementary-MOS shift-and-hold circuits with 32 outputs per chip furnish the panel's driving waveforms. As shown in Fig. 2b, data for each line is loaded in the horizontal-scanner shift register while data for the previous line, loaded in the holding register, is supplied to the active matrix. When the new data is loaded into the holding register, a single logic 1—which is loaded into the vertical-scanner shift register at the beginning of the frame—is advanced by one clock pulse in order to activate the next gate bus.

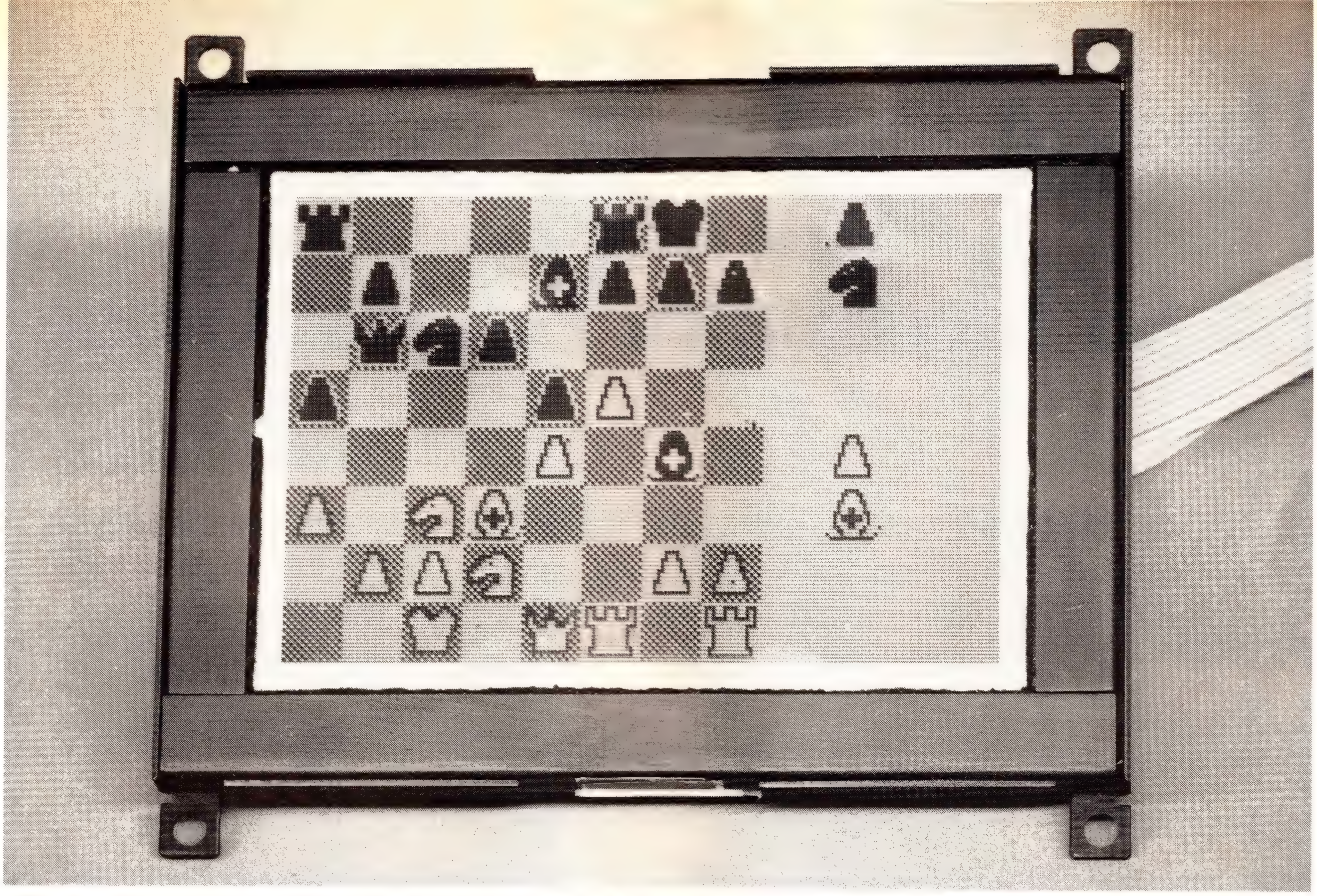
The horizontal clock, data, load, and output signals, and the backplane signal, are 0 and +5 V. The 18-V floating vertical supply connects at a suitable tap to V_{bp} bias of –5 to –10 V. The 18-V vertical clock and data signals are supplied through 5-/18-V voltage translators. The latter, together with a high-efficiency micropower 5-/18-V dc-dc inverter supply, are mounted on a separate voltage-level-shifter board. This, in turn, is mounted to the display frame, thereby providing the assembled display with full 0-to-+5-V operation.

The layers forming the circuit in the display's active matrix backplane can be fabricated in a variety of different sequences. In the sequence currently used in the PanelVision matrix (Fig. 3), the gate bus is first delineated, followed by the crossover insulator, which also acts as the dielectric in the elemental storage capacitor. Next, the source bus and drain-contact pad are defined, followed by the TFT. Finally, the ITO output electrode is delineated and the circuit passivated.

Display performance

The liquid-crystal assembly is simple and straightforward. The alignment layers are formed on both the active matrix plane and on the ITO-covered glass, the seal is printed, and spacers added. After the liquid-crystal is vacuum-filled, the seals and polarizers are laminated on the two outside surfaces. The liquid-crystal material currently used in this display is a standard twisted-nematic compound called EM 1490, containing an antireverse twist agent.

The finished panel is tested using a custom-built exer-



4. Thin profile. Providing an active display area of 3.84-by-2.56-in. with a thickness of 0.25 in., the MiniGraphic panel is suited for both alphanumeric and graphics display. It can operate in standard reflective or in optional transmissive, transreflexive, or backlit modes.

ciser. Panels that pass the tests are provided with a driver board carrying the horizontal- and vertical-line drivers. A high-density board, using wire-bonded chips, was designed to be mounted directly behind the display, taking up no more than the same area. Connections between panel and driver board consist of elastomeric conductor strips, held in position by an acrylic frame. The panel, conductor strips, and board are clamped together with edge-mounted C-channels. Finally, the panel is secured in a mounting frame, sealed, and subjected to environmental testing and burn-in. Eventually, the driver board may be replaced by integrated TFT scanners, further reducing display thickness and weight, adding reliability, and reducing cost.

Mode options

Containing a total of 24,576 addressable pixels, the display operates in a reflective mode, but it can be made in several other versions, such as transmissive, backlit, or transflexive. As a reflective display, it exhibits contrast ratios in excess of 8 : 1 and a viewing angle of better than 120°. The entire screen is written in 1/60 second. Figure 4 shows a typical display image, as it appears on the screen. With 24,576 pixels within a 3.84-by-2.56-in. active viewing area, the display is well suited for both alphanumeric and graphics use in medical and scientific instruments, process-control panels, and engineering tools such as oscilloscopes.

In its transmissive form, the MiniGraphic can project data on a screen. This is accomplished simply by placing the unit on an overhead projector in place of the usual inert transparency used in presentations. It thus forms an electronically addressable projection slide, a valuable feature with many uses, such as in large-screen presentations. In this form, contrast ratios in excess of 40 : 1 have been obtained.

In a backlit or transflexive mode, the panel uses a thin electroluminescent foil lamp, placed between the driver board and the screen so that it takes up no added space. Such units are suitable for both day and night viewing.

Currently, the display's drive registers provide only monochrome operation. But a gray-scale video option may eventually be made available through a simple change of the input registers to accommodate analog voltage levels. Good-quality video (limited only by the low screen resolution) has been demonstrated in PanelVision's laboratory, in both reflective and in projection modes. While the power consumed by the panel alone is less than 1 milliwatt—a figure that is related to the charging of bus and cell capacitances—the assembly's total power consumption, including horizontal and vertical scanners and voltage-level shifters, is approximately 40 mW.

The display easily interfaces with digital systems because of its standard 60-Hz frame rate and 0- and +5-V signal and supply levels. To provide essential control functions for user interfacing, a highly versatile display controller, based on Intel's 8031 microprocessor, has been developed to provide both serial and parallel data ports, a 12-bit direct-memory-address port, pixel addressability, and a keyboard interface. Together with an onboard character generator and a bit-mapped refresh memory, it provides great flexibility in both alphanumeric and graphic applications. Other features include programmable screen format, reverse video, step-and-smooth scrolling, and cursor control. ☐

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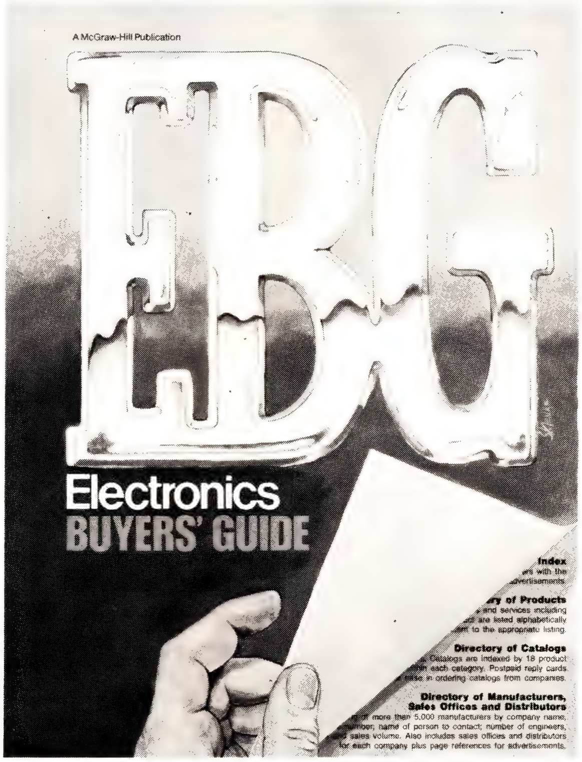
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Leased-line and videotex applications are targets of one-chip modem

On-chip digital signal processing takes care of many popular standards in one shot

by Stevan Eidson, *Advanced Micro Devices, Inc., Sunnyvale, Calif.*

☐ Today's box-level modulator-demodulators are prime candidates for replacement by large-scale integrated circuits that perform the conversion functions needed to interface the baseband digital world of microprocessor-based host systems to the frequency-shift-keyed domain of local telephone companies. Single-chip modems are the latest stage in the drive to shrink system modules to cut size, cost, and power consumption, since the most important way of attaining those goals is to place more functions on the same area of silicon real estate.

What is sparking the pace of change in the technology for modems implemented on single ICs is the use of on-chip digital signal processing. Besides integrating modem functions, this technique provides for the implementation of several kinds of modems, each specified to support various transmission speeds, modes, media, and such special applications as videotex—all on the same IC. A few external components are all that may be needed to complete the connection between a host system and a phone company's local loop.

The Am7911 is a single-IC modem that uses on-chip digital signal processing. To this chip must be added circuitry needed to deal with the local loop and to support the integration constant for the analog-to-digital converter, as well as a crystal with load capacitors to supply the clock. The resulting module is ready to receive its first mode command, at which time the on-chip digital signal processing takes over to configure the modem to one of several standards—or to a variation of a standard—depending on the telecommunications need.

The IC meets all widely used worldwide FSK modem standards. Operating at both 300 bits per second in the full-duplex mode and at 1,200 b/s in the half-duplex mode, it performs the major interface, modulation, and demodulation functions. At 300 b/s, the IC implements the Bell 103 standard and the International Consultative Committee for Telegraphy and Telephony's V.21 standard, while at 1,200 b/s, it implements the Bell 202 and CCITT V.23 standards. In addition, the IC is compatible with a recent 300-b/s full-duplex recommendation: the CCITT R.20 specification (see "Sizing up a new CCITT modem spec," below).

Back channels

All the 300-b/s modem types are full-duplex; half-duplex modems allow 1,200-b/s transmission in one direction, while lower-bit-rate back channels operate in the reverse direction. (Full-duplex FSK operation at 1,200 b/s is impractical over the public-switched telephone network because amplitude and phase distortions limit the bandwidth for data communications to about 2 kilohertz.)

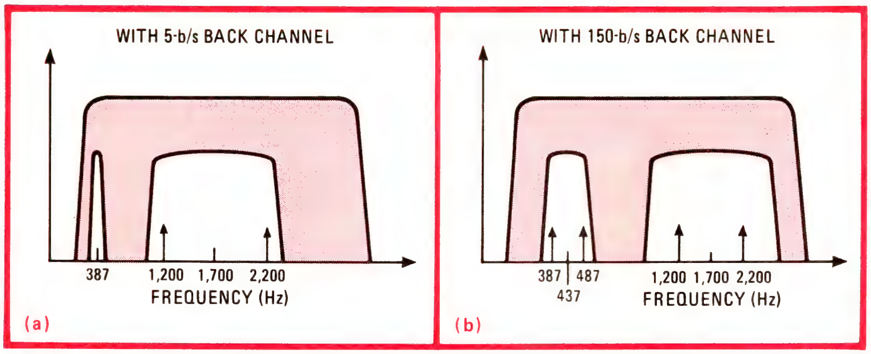
In many cases, a half-duplex system with a low-bit-rate

Sizing up a new CCITT modem spec

The CCITT R.20 recommendation deals with the specification of a new 300-bits-per-second full-duplex modem on the public-switched telephone network. Frequency-bandwidth allocation, interface connections, performance, line-signal levels, line-terminating impedance, high-voltage transient protection, and out-of-band transmitter energy are all detailed in the recommendation. CCITT R.20 allocates the same frequencies that V.21 specifies, and the interface specified is the one V.24 (RS-232-C) uses.

One section of R.20 specifies the transmit-and-receive signal levels allowed on the telephone network. Although the 7911 generates a nominal −3-dBm transmitter output and the R.20 specifies a −13-dBm output, a properly designed two-to-four-wire hybrid or a data-access arrangement will reduce the output to the desired level. Because the transmit-level tolerance across all 7911 modem types is 0.5 dB, the components in the data-access arrangement and the hybrid do not have to be adjustable to yield the required output level.

For the R.20 specification of receiver levels, the carrier-detect levels that V.21 specifies have simply been reiterated. More important, the carrier-detect response times have actually been reduced. Carrier-detect response time is a measure of the period from the appearance of a valid carrier at the modem's receive-carrier pin to the activation of the modem's carrier-detect signal. A similar figure is given for the removal of a valid carrier and the deactivation of the carrier-detect signal. For both carrier-detect-on and carrier-detect-off delays, the 7911 conforms to the timing specification established for R.20.



1. Higher back-channel rate. Conventional Bell-202-type modems provide a 5-b/s back channel (a) to control the direction of the 1,200-b/s main channel. A newer specification permits the use of a 150-b/s back channel (b) for such applications as videotex terminals, which require only low-rate transmissions for user entry.

back channel is preferable to a true half-duplex system, so both the Bell 202 and the V.23 standards have defined back channels. The V.23 back channel is a 75-b/s FSK data channel, and the standard Bell 202 back channel is a 5-b/s on-off keyed signaling channel.

For terminal applications—and, more specifically, for videotex—data must be received at high speed, but transmissions can occur at a much slower rate geared to human reactions. Slow data-transmission rates can be tolerated because even the fastest typists cannot exceed a 150-b/s rate. For this reason, the widely successful Canadian Telidon videotex program—based on low-cost modems—has specified a 150-b/s back-channel specification for the Bell 202 modem.

The IC lets users choose between the standard 5-b/s signaling channel (Fig. 1a) and this faster back channel (Fig. 1b). The IC's V.23 back channel has also been modified to permit communication at both 150 and 75 b/s. Activation of the particular modem type—a function of the 7911 interface control—is selectable with five mode-control pins (Fig. 2). Both the receiver's analog-to-digital converter and the transmitter's digital-to-analog converter are integral to the IC, allowing the implementation of on-chip digital signal processing (see "Testing the waters—digital signal processing on one chip"). The transmitter's d-a converter signals are generated at a high sample rate, higher than 100 kHz.

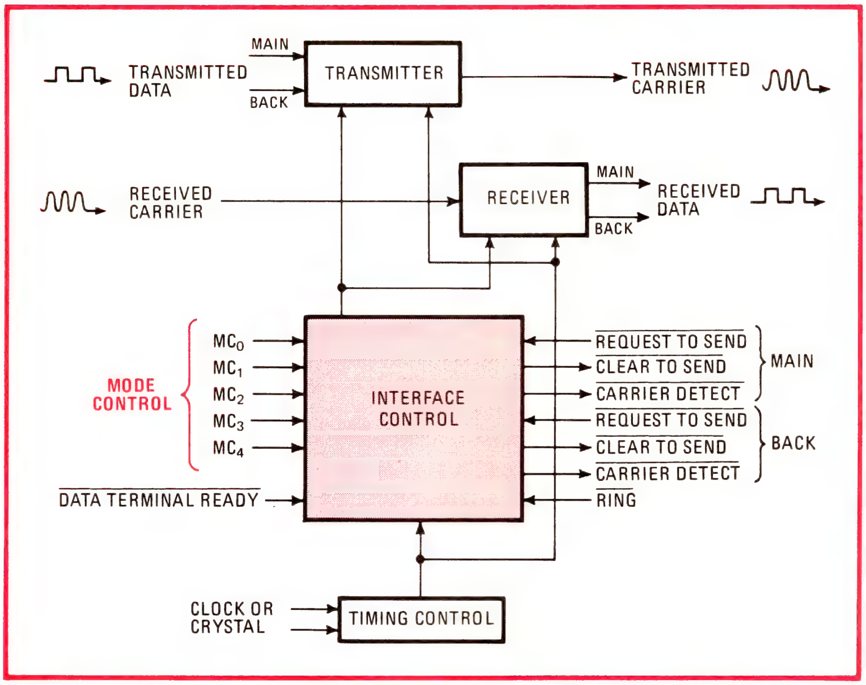
With digital signal processing and the integral d-a converter, the IC can hold the output of all kinds of modem transmitters to within 0.5 decibel of one another on any 7911. When all kinds of modems are compared across many parts, the tolerance broadens to 0.7 dB. The d-a converter can drive a low-impedance (600-ohm) telephone line directly.

Abundant samples

To supply an abundance of values for evaluation by the receiver signal processor, the interpolative a-d converter makes use of adaptive delta modulation at a sample rate that is near 500 kHz. The delta-modulation method that is used compares the previous sample's analog value as reconverted on a secondary internal d-a converter to the integral of the input signal received since the last sample. This comparison yields a binary decision to increase or decrease the digital input to the secondary d-a converter, which is also the input to the receiver signal processor.

A built-in interface-control state machine controls both transmitter and receiver signal processing and handles the timing of all essential RS-232-C/CCITT V.24 serial-interface signals. As defined by Bell 202 and V.23, the half-duplex line-turnaround protocol requires a period of silence, or squelch, to be observed at the end of the main-channel transmission. The interface-control state machine supports this squelch function and also the soft turn-off option—specified only for Bell 202—for both 1,200-b/s modem standards. With the soft turn-off option, a 900-Hz tone is emitted by the transmitting modem at the beginning of the squelch period to warn the receiving modem that no more data will be transmitted.

To help identify communications-system faults, the IC provides analog-loopback test modes for all modem types. These loopback modes set both the receiver and the transmitter signal processors to the same fre-



2. Modem mode. After a set of logic levels has been applied to the five mode-control pins, the 7911's signal-processing algorithms go to work. The modem has personalities for half- and full-duplex, 300 and 1,200 b/s, and other special options.

Testing the waters—digital signal processing on one chip

The 7910 and the 7911 are the only single-chip modems that use digital signal processing to perform the frequency-shift-keyed modem functions; other systems use analog-switched capacitor filters. A digital-signal-processing approach to system design simplifies the silicon-wafer process because fewer fabrication steps are involved. Critical parameters involving absolute voltages, such as carrier-detect levels, can be set precisely, without any external components and without any fear of drift with time and with temperature.

Digital-signal-processing components can perform similar system functions with different filtering attributes stored in read-only memory, accessed on demand. This capability is demonstrated by the 7911, which implements several different modem specifications, although the general signal-processing functions that must be executed for each modem type are common to all the modems implemented.

As the complexity of systems increases, an analog architecture becomes unwieldy, while a digital architecture requires only minor modifications to implement new system designs. A whole family of products can thus be designed around a single digital architecture, though most complex analog systems are restricted to a single task. For some applications, an upward design employing a digital-signal-processing architecture could require the addition of nothing but additional on-chip memory.

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quency band. The addition of these loopback modes lets the IC operate as a 1,200-b/s full-duplex modem on a four-wire leased network; each pair of wires in a four-wire network is dedicated to transmission in one direction only.

An external 910-Ω resistor and a 0.002-microfarad capacitor, which together set the integrating constant of the a-d converter, are required to build a full-function modem, along with a crystal, its load capacitors, and a telephone-line interface. The crystal oscillator, which uses mismatched load capacitors for the most reliable start-up, has been designed around a parallel-resonance, fundamental-mode 2.4576-megahertz crystal with a 0.01% frequency tolerance. In addition, an external automatic power-on reset circuit can be incorporated in order to support the modem start-up. A simple resistor-and-capacitor circuit is sufficient if it asserts the 7911 reset pin for at least 1.4 microseconds after the positive power supply has reached 3.5 volts.

Because the 7911 was designed for two-wire, leased-line applications, the public-switched-telephone-network line interface actually comprises two parts: a two-to-four-wire hybrid, or duplexer, and a registered protective circuit commonly known as a data-access arrangement. The duplexer connects the single pair of telephone wires to the IC's two pairs of wires.

Official bodies

The data-access arrangement protects the telephone network from improperly connected or regulated equipment. Equipment connected to the telephone network must in turn be protected from the network environment. Each country has an official body that governs connections to the telephone system—in the U. S., the Federal Communications Commission, in most European countries, the postal and telecommunications authority (PTT). These agencies regulate such specifications as transmitter energy, network isolation, transient voltage protection, and on-hook/off-hook current and impedance.

The transmitter's energy requirements are guidelines pertaining to the acceptable amount of transmitted energy in the voiceband. Acceptable voltage levels are typically near 0.55 V peak into 600 Ω (–9 dBm). For instance, CCITT R.20 specifies that no more than 0.245 V peak into 600 Ω (–13 dBm) should be applied to a telephone network. In addition, network isolation is required to ensure that large common-mode voltages from power lines near the telephone wires do not destroy user equipment.

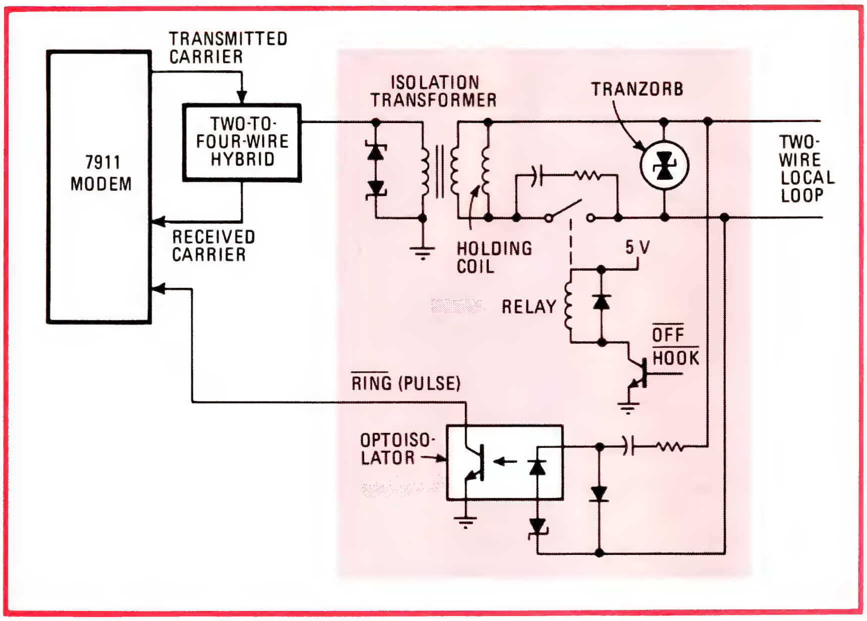
Isolation also ensures that a short circuit in the network or in user equipment does not hamper the proper operation of the system when the short circuit is cleared. In the past, network isolation has been accomplished with telephone isolation transformers, but newer data-access-arrangement schemes use active components.

Another function of the data-access arrangement is to protect the communications system from large voltage transients, such as those induced by lightning. Spikes of as many as several kilovolts can appear at the user end of a telephone network, but most national governing agencies specify a transient survivability of only 1.5 to 2.0 kV. The data-access arrangement must withstand these transients without harming the modem or any other kind of user equipment.

On the hook

Impedance and current restrictions placed on user gear let switched telephone-network equipment work properly. At the user end of the network, this equipment expects to see terminations with a high impedance (greater than 10 megohms) and a small current (less than 10 microamperes) for an on-hook condition. If the equipment is in the off-hook condition, the user-termination impedance becomes much smaller (near 600 Ω), and the current returned by the user's equipment through the telephone-company loop increases greatly, to almost 50 milliamperes. This change not only tells the telephone company the state of the user's equipment but also allows the company's equipment to be dormant when calls are not in progress. In a data-communications system, it is the data-access arrangement that controls the impedance and current characteristics the network sees.

Automatic control of the communication system's on-/off-hook state requires the data-access arrangement to sense the ringing signal the telephone company generates. The ring signal is typically a high-voltage (almost 100-V) and low-frequency (nominally 20-Hz) input to the data-access arrangement. Since neither the hybrid nor the modem is designed to accept such a high-voltage input, a



3. Isolation. The data-access arrangement isolates the modem/hybrid from the telephone company's local loop and vice versa. Ring-detection circuitry is added to warn the modem that a call is coming in.

separate ring-detection circuit that connects directly into the network is usually built into commercial data-access arrangements to provide signal isolation (Fig. 3).

Regulatory agencies require that every design for data-access arrangements be registered before it can be used on a telephone network. Designers should get in touch with their respective agencies to find out what regulations are applicable before they proceed with any design for a data-access arrangement. But a typical design—not approved for the requirements of any particular telephone network—can be described to enlighten new designers of data-access arrangements.

Ring detector

The output of the ring-detection circuit controls the system's on-/off-hook state through a relay that helps the data-access arrangement meet certain impedance and current requirements. A current-holding coil and two small resistors complete the circuitry required to meet the impedance and current requirements. A device called a tranzorb, which has the characteristics of a high-voltage, bidirectional zener diode, is used to meet the transient requirements set forth for a data-access arrangement, and an isolation transformer can provide network isolation. A capacitor prevents the transformer from passing dc signals to the modem.

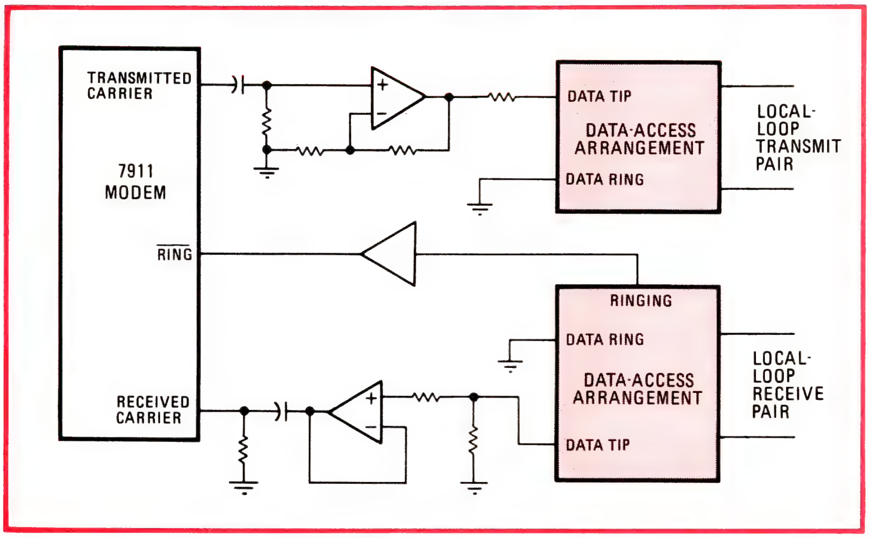
With the appropriate circuitry, the 7911 can be configured to support the requirements of individual telephone networks. But the specific communications applications the IC was intended for include not only the fastest-switching telephone networks, which are characterized by low delays between request-to-send (RTS) and clear-to-send (CTS) modem-interface control signals, but also low-delay, leased-line hook-ups and the newer videotex applications.

Leased connections

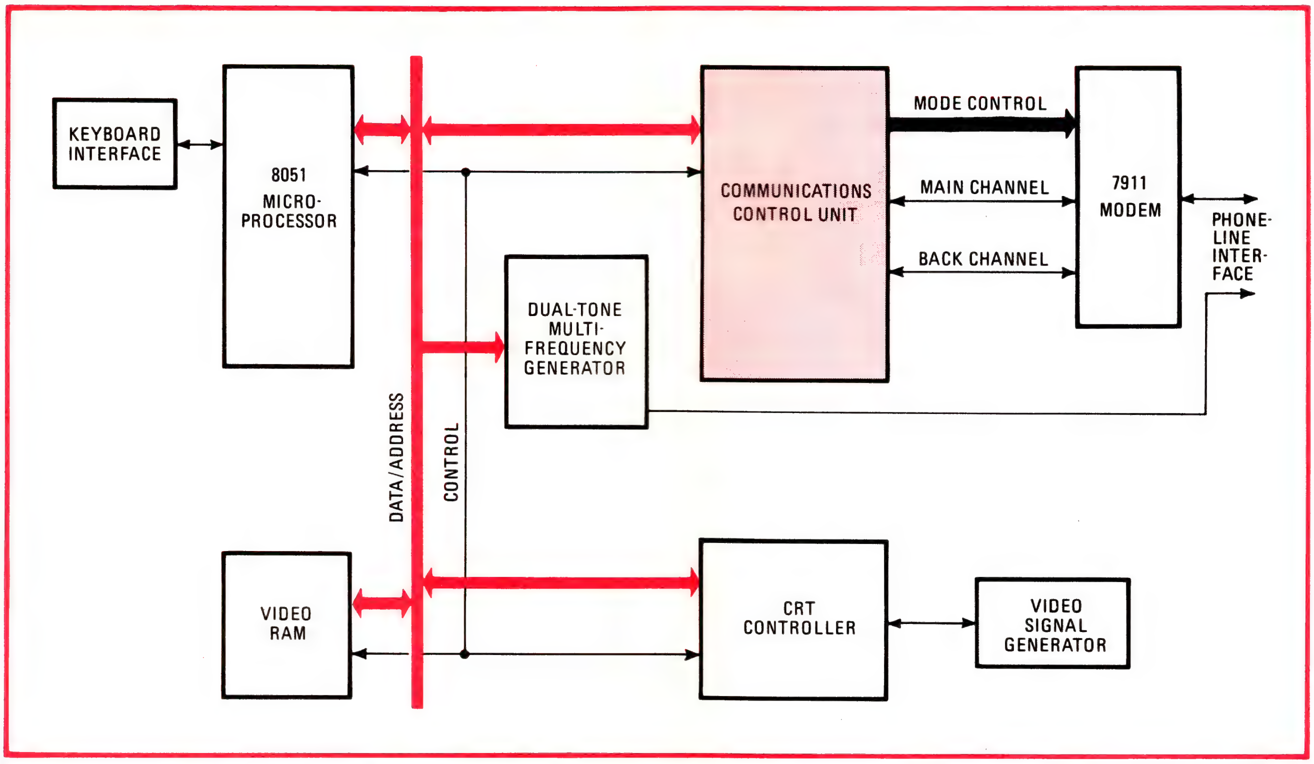
Leased telephone lines, demanding the most of modem performance, are fixed connections from one user site to another—as opposed to standard telephone-network connections, which are temporal functions of network loading. As a dedicated connection, a leased line has well-defined delay characteristics that are much shorter than the random delays on typical telephone networks. In fact, the shorter delays are in turn reflected in the Bell 202 and the V.23 timing specifications.

The transmitter energy allowed on a leased line is also well controlled because of the connection's unique characteristics. For this reason, users of leased lines can have their local telephone companies install programmable transmission attenuators. After measurements of the leased-line characteristics have been taken, adjustments can be made to the communications system to ensure that it transmits the maximum amplitude carrier allowed on the line.

Both two- and four-wire leased-line connections are available for data communications. A four-wire network has certain technical advantages over its two-wire counterpart but is less economical, since its equipment and cabling are more expensive than those of two-wire installations. But with four wires, it is possible to communicate in the



4. Full-duplex. Interconnection to a four-wire leased line requires two data-access arrangements, but the resulting communications system is capable of performing full-duplex operation (1,200 b/s in each direction) with only one modem chip.



5. Videotex terminal. This videotex-terminal design has a minimal parts count. The microcomputer-based communications control unit manages the system with the help of a 5-bit-wide port for 7911 mode control.

full-duplex mode without sharing the telephone bandwidth between two channels.

Furthermore, a modem that is used in a four-wire leased line need not reject energy in the adjacent frequency band and therefore improves system performance. The 7911 can be used both in two- and four-wire leased-line circuit arrangements. For leased lines, the two-wire network interface is the same as the telephone-network interface that is discussed above. Figure 4 shows a four-wire application circuit.

Unless the application requires full-duplex operation exclusively, the main- and back-channel RS-232-C interface signals each require individual universal asynchronous receiver-transmitters (UARTs). An addressable latch for mode selection is the only other logic that is required to connect the 7911 to its host microprocessor. On the network side of the modem, the interface circuitry consists of two data-access arrangements and two analog buffers in place of the two-to-four-wire hybrid that is required for a telephone-network or a leased-line two-wire connection. Both the transmitter and the receiver paths leading to the modem have one buffer and one data-access arrangement.

Sophisticated functions

For such sophisticated terminal functions as videotex, the communications system must deal with automatic calling, answering, and disconnect functions. Also regarded as standard are provisions for an 8-bit microprocessor interface and two serial RS-232-C/V.24 modem interfaces. These functions could all be incorporated into a single-chip microcomputer with two UARTs, an 8-bit microprocessor data bus, and a 5-bit port for the 7911 mode controls. Such a communications control unit would also control the data-access arrangement and the dual-tone multifrequency (DTMF) tone generator, which is used in automatic telephone dialing.

The system's communications control unit relieves some of the processing burden placed on the main processor and guarantees that the communications system gets top priority when critical timing is required. A complete videotex terminal (Fig. 5) with minimal support circuitry can be achieved using a communications control unit with a 7911, a cathode-ray-tube controller chip, and an Intel 8051. The 8051 controls all of the terminal's operations, such as data management of the video-display memory and of the keyboard interface, as well as handling the initialization of the other two very large-scale integrated controllers in the system. The terminal's configuration parameters should be controlled from the keyboard; the 8051 interprets and acts upon these commands from the keyboard.

Several CRT-controller ICs suitable for videotex terminals are available. These chips generally require a precise clock input or a crystal to generate a steady raster-scan display. CRT controllers for videotex are character-memory-mapped, which means that each location in the video memory represents a character on the display. Static random-access memory is generally used for the video memory because refresh circuitry required for dynamic RAM would raise the terminal's cost.

The 7911, with its capability for a 150-b/s back channel, rounds out the videotex terminal. Because videotex is intended for use on telephone networks, a two-to-four-wire hybrid and a data-access arrangement are required in the system. ☐

Robot Basic integrates functions to facilitate off-line programming

Hybrid software lets operators visualize motion and tool control, monitors sensory input and vision to minimize assembly-line downtime

by Roland Woodcock, *Intelledex Corp., Corvallis, Ore.*

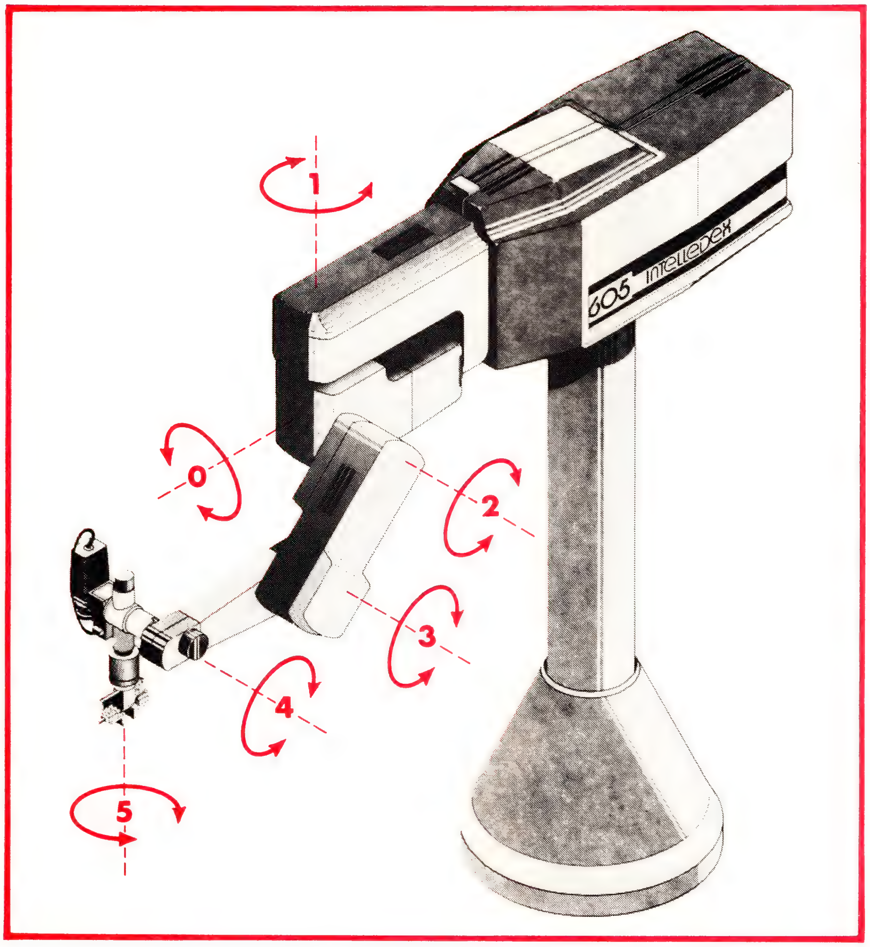
☐ The role of software in a robotics system is one of integration: controlling arm motion, monitoring sensory input and vision-system operation, and controlling tool use. Software design therefore must make it easy for operators to understand, visualize, recall, and predict movement commands and must interface with a wide range of hardware devices, such as strain gages and stepper motors.

In addition, since assembly-line time is costly, off-line programmability is advantageous in reducing downtime. A key to speeding up this programming even further is the development of Robot Basic, a variant on the well-known high-level language, combined with a personal computer for the development of application software. Robot Basic greatly eases the task of programming the new Intelledex robots.

A six-axis robot arm, such as that on the Intelledex Model 605 (Fig. 1), can make a wide variety of movements. With its six joints adjustable in angle by stepper motors, its function closely resembles that of the human arm, but it is capable of more complicated movements such as bending backward at its elbow. When six motors move simultaneously, the resulting complex motion proves difficult for human operators to visualize. In addition to generating commands powerful enough to take full advantage of a robot's enormous flexibility of motion, software designers are also required to make it as easy as possible for operators to comprehend the motion resulting from each command. In striving for these goals, the designer must strike a balance between ease of use and power consumed.

These goals concern the operator's control of the robot arm through the keyboard or through a program of robot commands. Equally important is the user's interaction with the business end of the robot—its hand tool, known as an end effector.

In the industry's infancy, the end effector was a set of vacuum cups or perhaps a simple air-driven parallel-jaw gripper. Now it may include a strain gage to monitor gripper force, a photodiode to check parts alignment, and a torque transducer to detect cross-threading of a bolt. End-effector and tool-control signals, as well as sensory signals, have proliferated to the point where they must be integrated into the command-lan-



1. Six-axis arm. A robot arm with six joints closely resembles the human arm but can perform more complicated movements, such as backward bending of its elbow. Operators have a problem visualizing robot motion when six motors move simultaneously.

guage structure, resulting in another software-design goal: it should be easy for the user to develop, test, and apply sophisticated end effectors.

To minimize critical downtime, two additional software goals were set for the Intelledex robot: to reduce robot programming and teaching time and to permit off-line program development. Teaching a robot a new sequence of tasks is slow; many robots require lengthy on-line teaching sessions to painstakingly walk through each motion in a new task sequence, during which time the robot is unavailable for use. Through the use of flexible software design, the programming and teaching time for a new task was dramatically reduced. For many applications, the robot need only be taught three points to define the coordinate system of its work cell; the robot can then use blueprint dimensions to compute the points it must reach to accomplish its task.

Further, it was noted that total downtime could be reduced to as little as 1 hour if programming were prepared off line while the robot continued to work. This was accomplished by using a host computer—a low-cost personal computer—as the user's interface to the robot's central controller.

Hardware constraints

Software design was constrained by a complex hardware system. Among the hardware goals for the Intelledex robot were that it have six axes, be of anthropomorphic design, and move with high precision, accuracy, and speed. The resulting heavy computational and data-passing needs led to a distributive-processing system in which the load is shared by 15 microprocessors, plus one for the optional vision system (Fig. 2).

The robot controller is an 8086 with an 8087 coprocessor to perform such mathematical computations as coordinate-transformation calculations. Controlling the stepper motor at each joint are two Z8 microprocessors, for a total of 12. One in each set, the master Z8, transmits motor-control commands from the main controller (the 8086) to the second Z8, the slave, which translates these commands into motor-driving signals. The master Z8 also monitors the angle of the motor shaft, returns this information to the main controller, and calls an emergency stop if it detects a stalled motor.

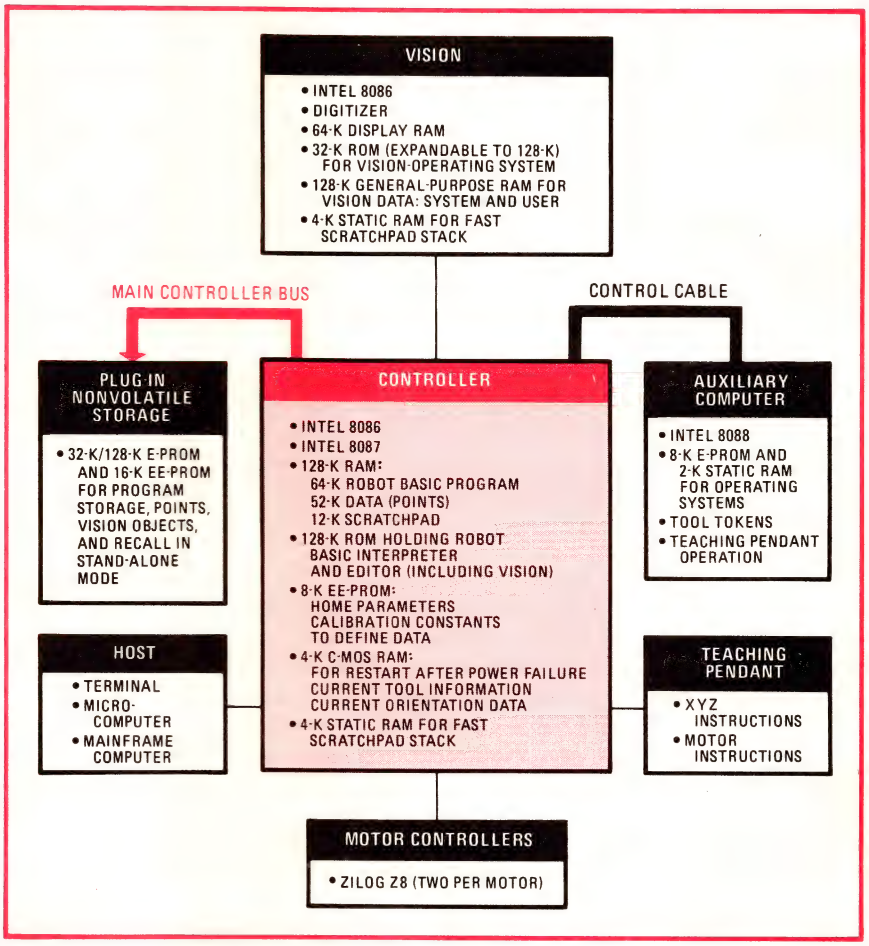
The system's auxiliary computer uses an 8088 to interface the system to end effectors and safety devices, such as pressure mats, light curtains (beams of light used in burglar alarms), and safety-stop switches. The optional vision system uses an 8086 and an 8087 for control and for such computations as image processing.

Implicit in this design is the idea that the robot is a computer, with its arm functioning as a peripheral. The personal computer, through which the user communicates with the robot, does not actually carry out the robot's complex operations. When connected to the robot, it functions essentially as a dumb terminal and provides disk storage for task programs. Thus, once a task program has been stored in the robot's memory, the robot can function autonomously; the personal computer can be disconnected and used elsewhere for off-line programming.

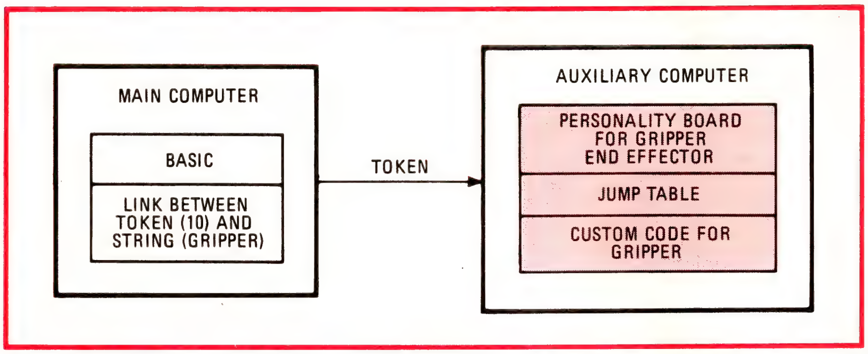
Personality cards

The basic design approach was to use an existing high-level language for the interface between user and robot, merging this language with a custom software system for controlling the robot's hardware. Not only did the availability of readily adaptable high-level languages make implementation cost-effective, but by designing a custom software package in house, the integration of motion control, end-effector operation, and vision into a common command structure was made feasible.

First, a robot command was defined. An example is Move P, which initiates movement to position P. This command was divided into a sequence of small tasks,


VISION
• INTEL 8086
• DIGITIZER
• 64-K DISPLAY RAM
• 32-K ROM (EXPANDABLE TO 128-K) FOR VISION-OPERATING SYSTEM
• 128-K GENERAL-PURPOSE RAM FOR VISION DATA: SYSTEM AND USER
• 4-K STATIC RAM FOR FAST SCRATCHPAD STACK
MAIN CONTROLLER BUS
CONTROL CABLE
PLUG-IN NONVOLATILE STORAGE
• 32-K/128-K E-PROM AND 16-K EE-PROM FOR PROGRAM STORAGE, POINTS, VISION OBJECTS, AND RECALL IN STAND-ALONE MODE
CONTROLLER
• INTEL 8086
• INTEL 8087
• 128-K RAM:
64-K ROBOT BASIC PROGRAM
52-K DATA (POINTS)
12-K SCRATCHPAD
• 128-K ROM HOLDING ROBOT BASIC INTERPRETER AND EDITOR (INCLUDING VISION)
• 8-K EE-PROM:
HOME PARAMETERS
CALIBRATION CONSTANTS
TO DEFINE DATA
• 4-K C-MOS RAM:
FOR RESTART AFTER POWER FAILURE
CURRENT TOOL INFORMATION
CURRENT ORIENTATION DATA
• 4-K STATIC RAM FOR FAST SCRATCHPAD STACK
AUXILIARY COMPUTER
• INTEL 8088
• 8-K E-PROM AND 2-K STATIC RAM FOR OPERATING SYSTEMS
• TOOL TOKENS
• TEACHING PENDANT OPERATION
HOST
• TERMINAL
• MICRO-COMPUTER
• MAINFRAME COMPUTER
TEACHING PENDANT
• XYZ INSTRUCTIONS
• MOTOR INSTRUCTIONS
MOTOR CONTROLLERS
• ZILOG Z8 (TWO PER MOTOR)

2. Load sharing. A distributive-processing system is required to handle the precision, accuracy, and speed requirements of the six-axis robot. The main controller is an 8086 aided by an 8087 coprocessor to perform mathematical calculations.


MAIN COMPUTER
BASIC
LINK BETWEEN TOKEN (10) AND STRING (GRIPPER)
TOKEN
AUXILIARY COMPUTER
PERSONALITY BOARD FOR GRIPPER END EFFECTOR
JUMP TABLE
CUSTOM CODE FOR GRIPPER

3. Personality cards. A token—for example, the number 10—informs the robot software system where to find the op-code signals on the end effector's personality card. The op-code signals are then converted to control signals to operate the end effector.

such as "set value of velocity for drive motor" or "request motor-shaft angle data." Each task was given a short label, called an operation code. Then these elemental instructions were assembled to yield the desired response to the command Move P. This arrangement allows great flexibility for tailoring new commands.

Basic was considered the best programming language because it is widely known, easily learned, and offers the advantages of easy writing, programming, and debugging. Its interpretive nature is not a drawback, because it easily outruns the fastest robot motion. In fact, an interpreter allows on-line command processing. Operators at the keyboard of the robot's host computer can enter commands one at a time, building their intuitive understanding of each command by observing its resulting action—or they can verify a program they have written by watching the ensuing motions of the robot.

Also in Basic's favor was the existence of Microsoft's Basic 86, which Intelledex licensed from Microsoft and which offers the advantage of easy interfacing; its interrupts allow file manipulation and facilitate the addition of robot commands. Well established with software and hardware companies, it has a ready availability that makes it a cost-effective high-level-language component of a hybrid software system (the op-code language is the other component).

To take full advantage of a high-precision, six-axis, anthropomorphic robot required 150 specialized commands. For an operator to visualize each movement, command names were chosen with appropriate mnemonics. For example, the movement sequence

Move straight P
IMOVEZ -2.3

instructs the robot to move first to the absolute real-world coordinate, position P (a previously defined array of coordinates), and then to make a move relative to that position (an Incremental Move) downward 2.3 inches along the Z axis. Vision commands are all identified by the prefix V: examples are Vsubtract, Venhance, and Vthresh. The prefix T denotes tool commands, such as Taffix, Tdetach, Tuse, and Tstatus. Sample system commands are COS87 and SQR87, which invoke calculations by the 8087 when the robot's high precision demands greater computational accuracy or speed.

Custom robot commands were added to Microsoft Basic 86 and then melded with the robot's op-code, resulting in pliable software. Software is called pliable if it allows future changes in robot commands and end-effector control without changing the software itself.

For example, if the user develops a new end effector that requires a specialized command or one for which no tool command exists, the problem becomes how to change commands without changing the system software. The problem is complicated by the fact that the operation of the end effector itself requires custom code, and it is not possible to predict exactly what its storage needs are going to be.

The solution is in the form of a personality card for each end effector, a custom interface between the end effector and the auxiliary computer. This card receives op-code signals and converts them, using custom code in its read-only memory, into the control signals required by the end effector. Code in read-only memory also conditions end-effector sensor signals to allow their transmission to the robot's central controller. Personality cards allow software expansion without changing the core system software.

An example of how users might customize their own robot commands might be a pneumatically operated gripper designed to hold a component that is 1.1 in. wide. The command Tuse (for Tool Use) was designed to allow the creation of custom commands. In this case, users might want to create the command

Tuse "Gripper"

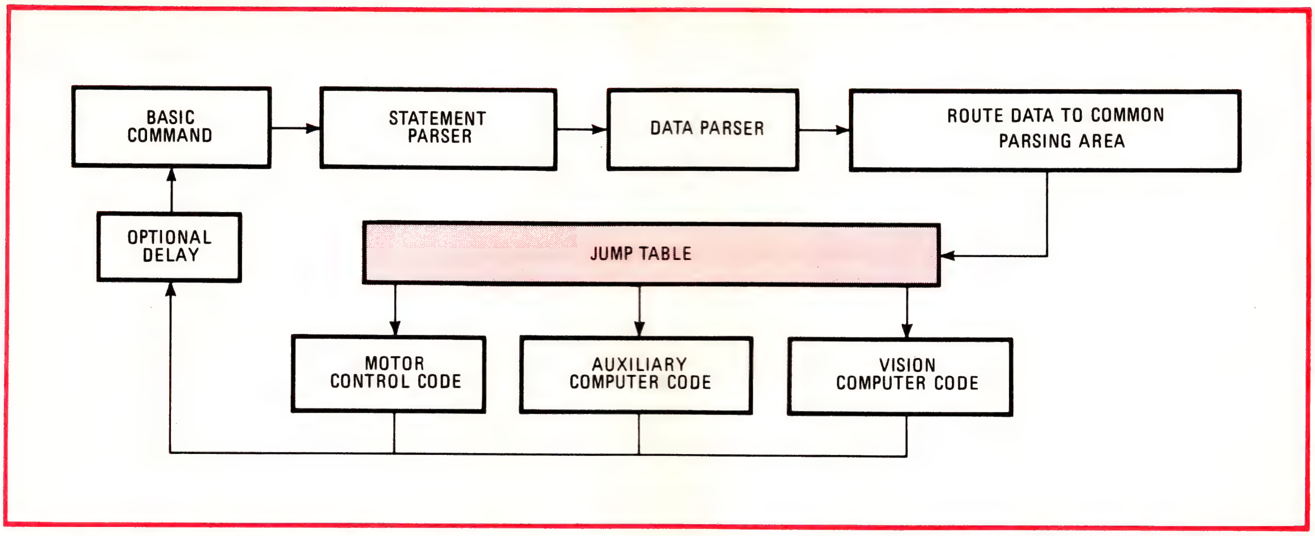
where Gripper is an arbitrarily chosen descriptive label. This command can be defined with the command-definition statement TDEF (for Tool Define) and appropriate parameter definitions:

TDEF "Gripper" 10, 4, 1, 1.1.

The first parameter associates the string Gripper with the number 10, a token that tells the robot software system where to find the appropriate special code on this end effector's personality board in the auxiliary computer (Fig. 3). When the command Tuse "Gripper" is issued, the controller passes the token to the auxiliary computer, where it is used as a jump-table offset to locate the address of the custom code. This special code also contains the information defined in the remaining parameters in the TDEF statement.

The second parameter establishes a fixed delay, in tenths of a second, between the initiation of tool action and the execution of the next Basic instruction. This delay gives mechanical devices sufficient time to complete their motion before the program continues. In this case of a pneumatically controlled gripper, the value 4 sets up a 0.4-second delay to allow the jaws to close. The default value of 0 yields no wait.

The third parameter produces a delay of return to the program, but the length of the delay is conditional. Such a delay allows testing for the completion of a process,



4. Jump table. A jump table and an area of random-access memory reserved for passing parameters help maximize the amount of RAM available for user programs. Codes for robot commands take up three times the space of Basic.

which is quite useful when the completion time is not readily predictable. In the example, the parameter value of 1 causes the return to the program to be delayed until successful clamping of the component has been verified. A successful clamping might mean that the jaws have encountered a resisting force of, say, 6 ounces, as indicated by a strain gage.

The fourth parameter sets a default value for the "amount of action," in this case, jaw separation of 1.1 in. In normal use, the amount of action is specified by the parameter Tuse. For example, to set the jaw opening to 2.3 in., the command given is

Tuse "Gripper," 2.3.

But since the fourth parameter of TDEF sets the default to 1.1 in., issuing the bare command

Tuse "Gripper"

will cause the jaws to close to within 1.1 in.

Overcoming software obstacles

The designers of the Intelledex software encountered two major obstacles. The first was a conflict over the proper use of random-access memory. It was important to reserve as much of Basic 86's 64-K bytes of RAM as possible for user-written robot task sequences. But it was also necessary to communicate with robot commands, with code almost three times greater than that of Basic 86, requiring large amounts of data to be accessed and returned. Since neither user- nor system-generated code can overwrite the main area of the Basic 86 RAM, a jump table handled the passing of instructions (Fig. 4). Strictly reserving an area of RAM for passing parameters handled the transmission of Basic variables.

The second problem involved the unusual demand placed on subroutine returns required for robots. Basic treats robot commands as subroutines, but there are complications. In addition to normal completions of subroutines, there are returns with errors, which may be of different priorities. Of intermediate priority is a location-inaccessible error, such as a robot directed to a position outside its work envelope. This error is not critical and Basic can trap, or ignore, it if desired. But an emergency-stop situation creates a top-priority, or nontrappable, error condition.

A problem then arises, since when Basic executes a subroutine, it places pointers on a stack for use when control returns to the main program. An unexpected emergency-stop signal disrupts the proper unraveling of the stack. This problem has been solved by cleaning up, or erasing, the pointers that Basic will see when control is returned by the robot-command code. The cleaning up is done in the parameter-passing area, before control has left Basic.

Robot simulation

To simulate the robot in order to do off-line development of a robot task program, a special simulator disk is loaded into the personal computer. Any IBM-compatible personal computer can be used because its 8088 is compatible with the robot's 8086 and because it offers a slot for the 8087. The disk, which contains Basic with its robot extension, makes the personal computer think that it is interacting with the robot, thus making it emulate, or simulate, the robot. The computer can now be used to write and debug a task-sequence program while disconnected from the robot. And the finished program can then be saved on a disk.

When the time comes to change operations on the assembly line, the robot is stopped so that it can be given the new task sequence. First, the operator connects the personal computer to the robot and boots it with a special disk, known as the host disk. The personal computer now functions as a terminal to the robot. The task program is downloaded from the computer to the robot's RAM; the robot can then proceed with its task when commanded by the personal computer. Alternately, the program can be stored in nonvolatile robot memory; the operator can start the program automatically from the robot's controller console. The personal computer can be removed for more off-line programming while the robot continues to work. ☐

Engineer's newsletter

LCD reliability testing program now available

As many electronic-design engineers know, very little quantitative reliability information is available on either dichroic or twisted-nematic liquid-crystal displays. Rome Air Development Center (RAC), in conjunction with Mesophase Inc., Cupertino, Calif., and Trio-Tech International, Burbank, Calif., is working to rectify this situation. The two industrial firms are conducting LCD test programs, while RAC is analyzing data from these tests and others. **The testing program's objectives are to create a complete set of quantitative reliability data on both LCD technologies, as well as to establish a set of standardized reliability tests and procedures** to support subsequent LCD reliability and performance testing. Persons or organizations interested in more information on this program should contact Robert Arno, RAC, Griffiss Air Force Base, N. Y. 13441, (315) 330-4151, or Kevin Hathaway, Mesophase Inc., 10675 South De Anza Blvd., Cupertino, Calif. 95014, (408) 973-8558.

Dual filters clean water of metal effluents

General Electric Co. scientists at the firm's Research and Development Center, Schenectady, N. Y., have developed a simple one-step procedure that cleans up industrial waste water and process streams containing dissolved metals, such as occur in printed-circuit plating. The new process dramatically reduces the size and cost of the process equipment. **The continuous metal-extraction procedure, which takes advantage of recent advances in membrane technology, uses two compact modules**—one to remove metals continuously as a stream of water is fed through the system, and the second to produce concentrated metal-containing solutions. The stream first flows into an extraction module, where it is routed through thousands of hollow fibers, or membranes. With an internal diameter of about 200 μm, each hollow fiber has microscopic pores and is resistant to corrosive attack. An organic solvent containing a liquid ion-exchange material is channeled into the spaces between the fibers. This solvent picks up metal ions that migrate outward through the pores in the fibers and carries them to a stripping module (a cylindrical chamber that contains a stripping solution). There, a special solution (which can be an acid, salt, or base) removes the metal ions from the solvent in a concentrated product stream; the solvent is then recycled to the extraction module. Since the modules do not have any moving parts, the system requires minimum maintenance. GE is now investigating potential applications for this technology at its various manufacturing facilities.

New guide lists 150 sensor designs

Sensors interface the parameters of the physical world to electronic instruments and systems. A new book by Harry N. Norton, "Sensor Selection Guide," published by the Swiss firm Elsevier Sequoia, compiles 150 sensor design specifications for measuring solid-mechanical, fluid-mechanical, and thermal quantities, including a large selection of pressure transducers, accelerometers, and load cells. **Each design, with all its essential specifications, is described on a full page in a standardized format.** The book consists of a terminology section, data sheets, and a listing of manufacturers' addresses. Planned as a continuing project with new editions to come every two or three years, the guide sells for $15 a copy, including postage. For a copy, write to Elsevier Sequoia S. A., P. O. Box 851, 1001 Lausanne 1, Switzerland.–**Jerry Lyman**

SWITCHES

SPECIAL ADVERTISING SECTION

SWITCHES BEGIN WITH RELIABILITY TO MEET CHANGING NEEDS

A switch that doesn't work is somewhat like the sun refusing to come up in the morning. Just as few of us worry about the sun's daily arrival, designers generally give switches very little thought (and very little praise) when they perform as expected—but should they fail, look out!

Market-Driven Change

Fortunately, today's switches are very reliable, thanks to the toils of the engineers working for switch manufacturers. For the most part, advances in switches are driven by changing needs and requirements of systems designers—and switch designers have reacted superbly.

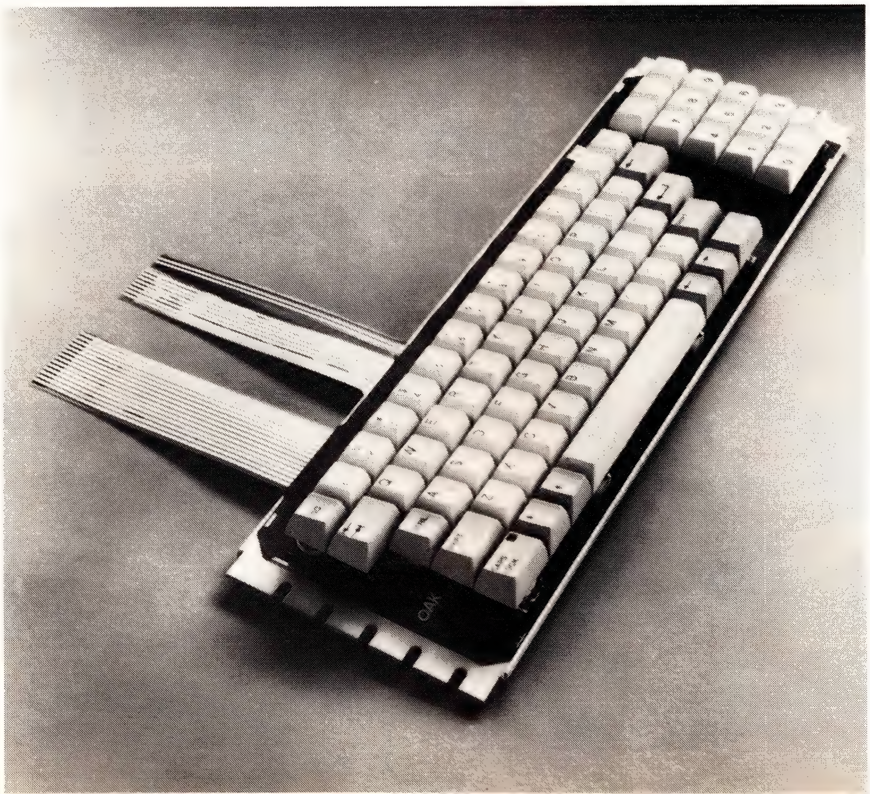
But as electronics changes every day, so do the switch makers' product offerings change in response to those evolving needs. Thus this report will focus on the overall market health and projections for the major types of switches: keyboards, pushbutton, rotary, thumbwheel, those in dual in-line packages, toggles, rockers, and paddles.

Also included is a discussion of the design considerations driving switch technology—such as miniaturization—as well as a healthy sampling of the newest product offerings. Rounding out this survey is a glossary of widely used switch terms for the uninitiated specifier of switches. In the age of microelectronics, the subject of switches and other passive components may not come up in formal classroom instruction, so a practical guide to fill in the gaps can be of real help to a specifier.

The proliferation of personal and portable computers and consumer electronic equipment like stereos, TV sets, and microwave ovens, as well as tone dialing on telephones, has created a growing need for keyboards. *Electronics'* World Market Forecast predicted earlier this year that the 1984 market for keyboards including keyboard assemblies, keypads, and matrixes will be about $255 million, growing to $359 million in 1987.

Although keyboards may appear to be a collection of individual keys, there are considerations that extend beyond the keys themselves. Indeed, with a keyboard, the whole is greater than the sum of its parts.

Oak Switch Systems Inc.'s low-profile full-travel membrane keyboard measures just 19.9 mm from the center of the home row of keys to the bottom of its lightweight aluminum plate. The Crystal Lake, Ill., firm's keyboard uses a rocker mechanism (patent pending) that imparts a distinct nonfatiguing feel for the keyboard operator. [Circle 460]



Keyboards Flourish

For instance, ergonomics is playing an important design consideration in personal computers and office-automation equipment. A low-profile keyboard is just one aspect of many in ergonomics. Such a keyboard, with a slope of from 5° to 15°, as specified by DIN, the West German standards institute, contributes to operator comfort, which in turn helps reduce errors and fatigue.

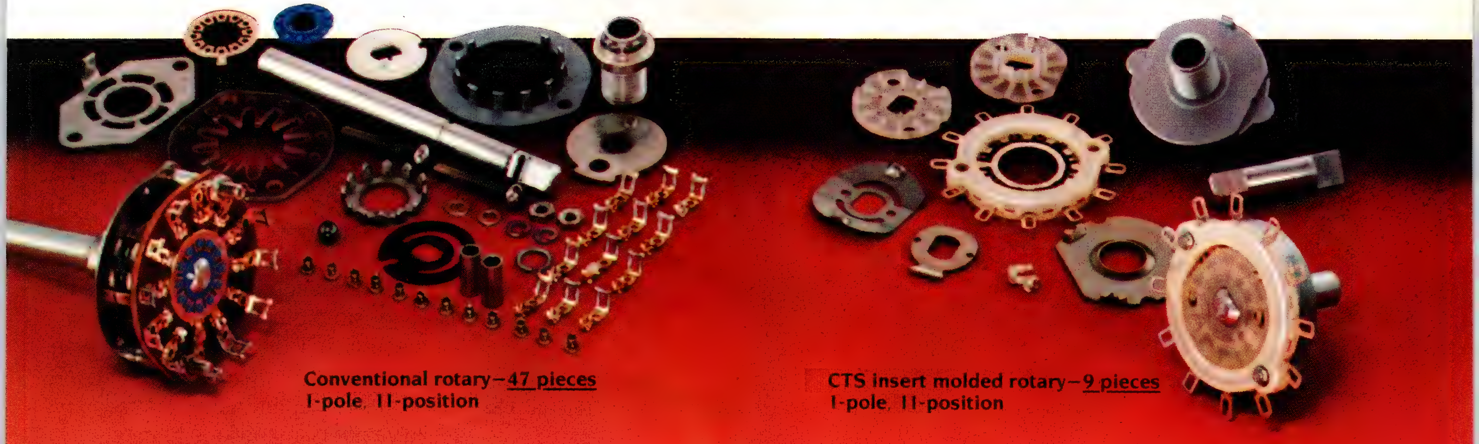
But the lower-profile requirements also affect the individual keys themselves. For example, the height of the home-row keys (A through L on a standard typewriter) are only 30 mm, or 1.18 inches, as specified by DIN standards. This in turn reduces the amount of key travel that is possible. Some keyboards offer travel as little as 0.125 in.

Of course, there are other parameters for the individual switches—such as life expectancy, contact resistance, dielectric strength, load-handling ability, resistance to hostile environments, and ability to withstand soldering stresses—that must be taken into consideration.

Other factors that affect the person

Cover photos: NKK Switches of America Inc. (toggle switch), Alps Electric USA Inc. (keyboards), and Omron Electronics Inc. (pushbuttons).

Smart engineers have always known that simplicity equals reliability



Conventional rotary—47 pieces
1-pole, 11-position

CTS insert molded rotary—9 pieces
1-pole, 11-position

Now you select the rotary selector switch likely to be most reliable

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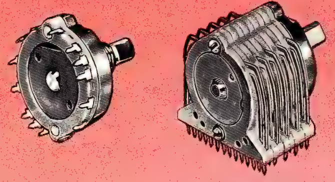
CTS offers thousands of PC board rotary switch variations—all with insert molded reliability



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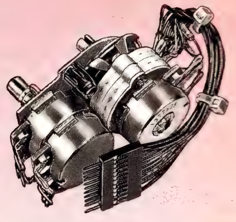

Type 212-450 Rotary switch/ potentiometer combination.
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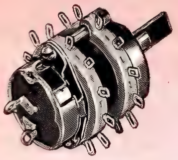

Type 227 Rotary switch/ power switch combination.
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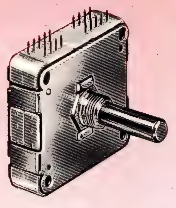

Series 230 20 to 40-position digital rotary switch.
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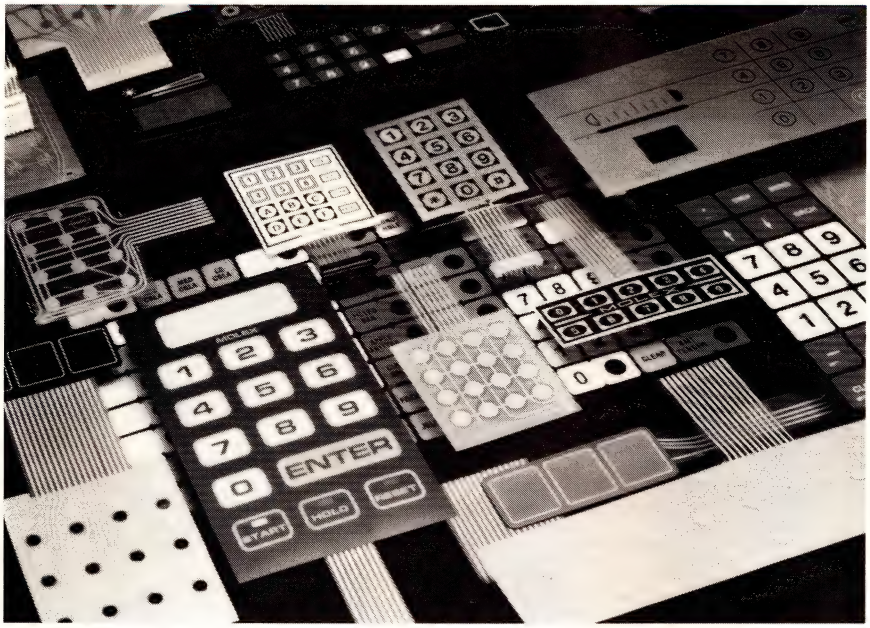
CIRCLE NO. 174



Molex Inc.'s various membrane switches are offered in three basic types: standard, tactile, and hybrid. The Lisle, Ill., company has four standard switch configurations available immediately from stock. The hybrid membranes have been specially designed so that integral displays and electronic components can be included in the switch. [Circle 461]

working with a keyboard are the keytops, graphics overlays, shielding, and mounting. Designers need to consider all of these when specifying a keyboard.

Most keycaps made today by the major manufacturers—Alps Electric Inc., of Rockville Center, N. Y.; KB Denver Inc., of Frederick, Colo.; Grayhill Inc., of LaGrange, Ill.; Rogers Corp., of Chandler, Ariz.; and Texas Instruments Inc.'s Attleboro, Mass., Data Controls operation—are made of injection-molded plastic. Two of the most common materials are polycarbonate and ABS polymer, the latter of which is typically used in two-shot molded applications, in which the legend is a piece of plastic molded right into the cap.

By far the most durable legend, though usually at a price premium, is found in the two-shot molded keycap. It is made by a process in which the legend is injection-molded in a transfer die and then part of the mold is rotated and the key is molded around the legend.

Hot stamping is one of the oldest methods of imprinting legends. A plastic film similar to a typewriter ribbon is placed over the keytop, and a hot die (similar to lead type) is forced under pressure onto the keytop, leaving the imprint of the legend. In high-use applications, however, the legends can wear off.

A newer process is tampo printing, in which the legends are imprinted with a special etching ink. The ink builds up and etches into the key (similar to anodizing of aluminum). Wearability is rivaled only by the two-shot process.

Other Keycap Types

Another keycap type, engraved and paint-filled legends, can meet many requirements. Again, in high-use applications, the fill may wear. However, engraving can be accomplished with minimal tooling.

Another approach is replaceable legends. A clear plastic snap-on cap, such as those from Dialight, New York, fits over a solid colored base key, and in between is a piece of paper with the legend.

Since keyboards are the components that interact with the user, they are logical locations for data displays, function or warning indicators, product and model identifiers, brand names, and corporate symbols. Two materials—polycarbonate and polyester—stand out among the many materials that can be used.

Polycarbonate is the most commonly specified material for the graphics overlays. Colors are extremely vivid due to the clarity of the raw material. Polycarbonate is available in several textured surfaces that resist scratches and provide a matte finish.

Chemical Destruction

However, polycarbonate is destroyed by many common chemicals. Some top coatings do protect against a number of these chemicals. In extremely harsh environments, however, it is best to stick with a tougher material.

Polyester is impervious to most common chemicals—including petroleum oil, alcohols, and aliphatic hydrocarbons, as well as wine, beer, whisky, coffee, and milk—and it is also structurally stronger than polycarbonate. It is available only in smooth and matte finishes, and colors are not as vibrant as in polycarbonate.

Polyester is not as clear as polycarbonate and does not transmit the color of the graphics symbols as well. Graphics overlays are typically printed on the underside and viewed through the material; this process is called second-surface printing.

Many electronic components today are sensitive to static discharge, particularly those fabricated in complementary-MOS and its derivatives, so wise designers shield their keyboards in order to protect the circuits from stray charges. Shielding should also be a concern of the designer if he or she must meet the requirements of government regulatory agencies or of international standards as set by various advisory or testing groups. Many companies, Grayhill and KB Denver among them, can provide static shielding.

Usually, this type of shield is very simple and is constructed of a material such as metalized Mylar applied between the outer layer of the keyboard and the switch layer. It is

Small, sealed and solderable. Three miniature switches from Oak.

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These switches are sealed against contaminants during wave soldering and immersion cleaning to enable automated, high volume assembly. A full range of design options is available to meet your specifications.

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The versatile Series 850 programmable rotary switch offers a remarkable choice of switch function, detent angle and PC board mounting locations in a package only 0.850" square.

Call or write us today for more information on these small, sealed and solderable switches. They're perfect for your microprocessor-based application!

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most often attached by means of a pressure-sensitive adhesive and grounded through its connector.

For protection from electromagnetic and radio-frequency interference, the same technology works well—except where the keyboard has windows or large open areas. In these situations, a shielded window is required and needs to be bolted to the keyboard. There are several manufacturers that build windows of this nature.

In terms of mounting, a keyboard is essentially a printed-circuit board. Four techniques of mounting keyboards in enclosures stand out as the most popular.

Four Techniques

Threaded studs can be provided with almost any style of keyboard. Consisting of a threaded steel stud designed to be force-fitted into a pc card, they are similar to the studs designed for sheet-metal connections. For use with graphics overlays, they must be installed in a counterbored hole in the pc card to allow the overlay to lay flush.

Pressure-sensitive adhesive is a suitable way to mount flat-panel keyboards, especially when the keyboard is mounted in a recess. A third mounting method uses holes drilled in the keyboard, which then can then be mounted with screws or studs.

Finally, some keyboards with bezels have plastic posts at each corner for mounting. These posts protrude through the customer's panel and are generally heat-swagged on the backside to capture the keyboard in place.

Not only must engineers design the keyboard, but they also must look at options that extend beyond the typical choice of selecting the type of keyboard that uses snap-action pushbuttons. For instance, they are now confronted with membrane keyboards, which are coming on strong in many home appliances. Another choice is in lighting keyboards, either by flooding the background or by lighting each and every key on the board.

Thinking of Membranes

According to Rogers Corp., which makes both dome and membrane keyboards, the electrically active layers of membrane keyboards, or touch panels, can be designed as two distinct circuit layers (each with its own interconnection tail); as a single layer folded to appear as two layers; or as a multilayer where one layer is constructed by alternately screening conductors and insulators or by plating though on an etched circuit where the second layer contains only shorting members and does not interconnect to the outside world. By selecting the correct construction among those options, keyboard designers can specify almost any interconnection pattern, yet obtain extremely cost-effective configurations for simple interconnection patterns.

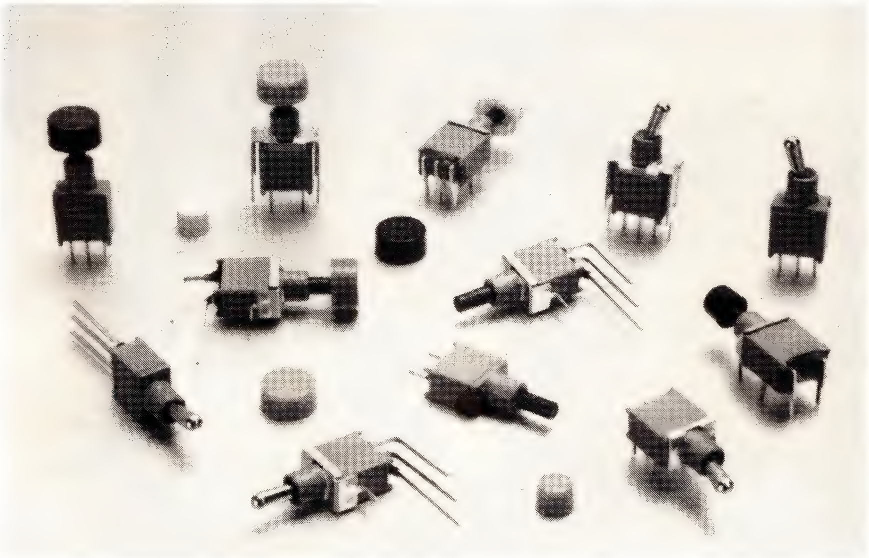
Membrane-switch keyboards are not taking off as well as they could, due to a number of problems. Bergquist Switch Inc., Minneapolis, whose value-added business in push-button switches has boosted it to into the membrane market, has been attempting to educate users by demonstrating potential areas of membrane failures. The first of a series of white papers lists the following as among some of the reasons membrane switches fail:

- Failures due to materials incompatibility.
- Failures caused by raw-material shrinkage.
- Failures in dielectric jumpers.
- The effect of pressure-sensitive adhesives on graphic inks.

Tracking Down Failures

Bergquist has done extensive accelerated aging tests at 100°C. Among its findings are that the degree of transfer of conductive silver ink to a pressure-sensitive adhesive surface is a function of the exposure time under the test conditions. The company says that longer exposures caused more silver to transfer to the adhesive surface, resulting in the plasticization of the silver ink's binder resin and a loss in conductivity.

"The product that differentiates Bergquist Switch from others is our heat-seal switch," says Carl Bergquist, founder and president of the company. "This product is built with both silver and copper traces, and the performance of the switch is unexcelled. Life testing of the heat-



As with the firm's sealed toggle switches, C&K Components Inc.'s pushbutton switches have ratings from 5 V to 1 A at 120 V ac or 28 V dc with two switching functions available. No special steps are required for installing the Newton, Mass. firm's switches: just solder and clean along with other components. [Circle 462] we make innovation work for you

Mil-S-83731 toggles. In 1 and 2-pole configurations with standard lever or lever lock operation.

PC board switches. Conform to standard spacing requirements.

New! Sensitive pushbuttons. In 1 or 2-pole configurations. Bushing or snap-in mounted. Solder lug or PC terminals, AC and DC ratings.

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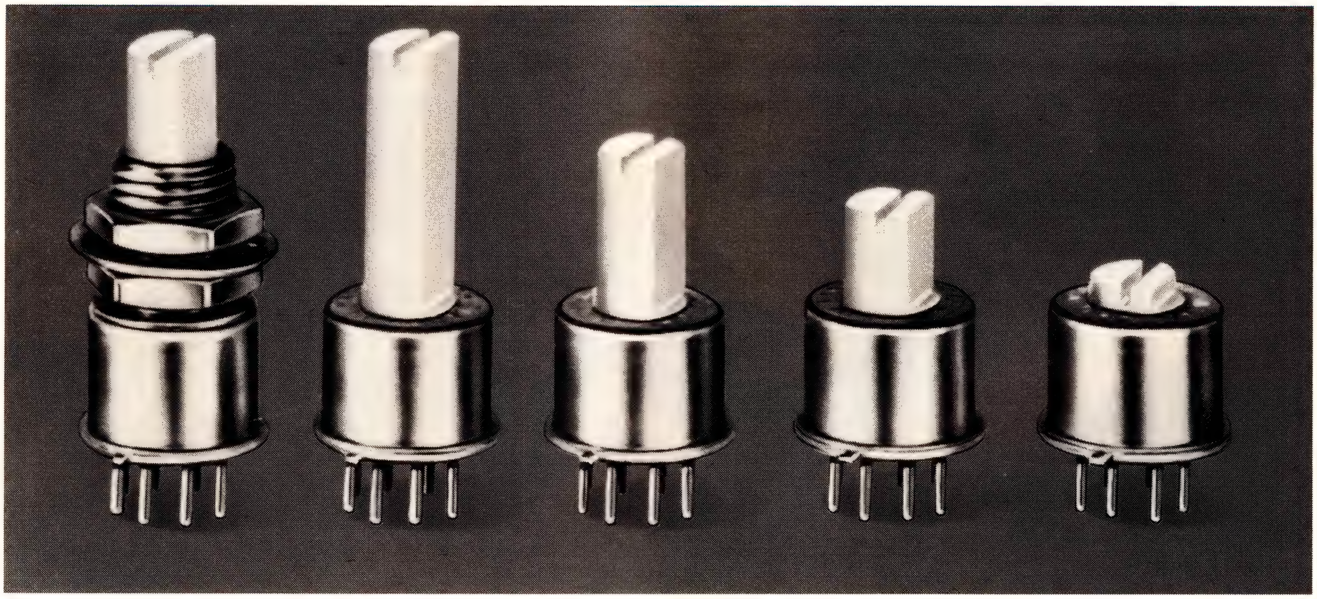
Circle 175 on reader service card



Suited for instruments, test equipment, process-control equipment, and computers, ITW Switches' subminiature rotary switch is available in up to eight positions indexed in 45° increments with single-pole switching or two-position, double-pole switching. The Chicago, Ill., firm uses gold plating over a nickel-plated copper alloy for its contacts, suiting applications requiring long-term, stable contact resistance. [Circle 463]

sealed switch has been in excess of 10 to 1 over pressure-sensitive adhesives at 98% relative humidity and 75°C conditions."

When it comes to lighting a keyboard, the designer's first decision is whether the application needs it. If the answer is 'yes,' then the next question is what kind of lighting will best suit the end user.

Light on the Subject

Grayhill, which specializes in lighted keyboards, prefers electroluminescent lighting. The EL lamp, a panel that is positioned beneath the graphics of the keyboard, is similar to a capacitor in that it consists of two conducting surfaces with a dielectric material between them.

The luminescent pigment is dispersed within the dielectric material and therefore will be subject to the electrostatic field of the charged capacitor. If an ac voltage is applied across the panel, the phosphor particles will be in a continuing state of excitation, giving off a steady light in the form of a glow. Of course, the graphics overlay must be chosen to allow light to pass through the desired areas.

An alternate route to backlighting is taken by KB Denver. Except with annunciator keyboards, the firm uses incandescent lamps for backlighting because incandescent light is easily diffused. It also can be filtered to create several different colors unavailable with light-emitting diodes, for example. Incandescent lamps are also used when the keyboard is to be backlit for night viewing because they can be hooked up through a variable resistance such as a potentiometer to adjust brightness.

LEDs are typically used only for indication and not for backlighting because it is almost impossible to diffuse their light output over medium to large areas, KB Denver maintains. Although almost any type of LED can be used with the snap-dome-switch technology, the firm prefers the axial-lead variety.

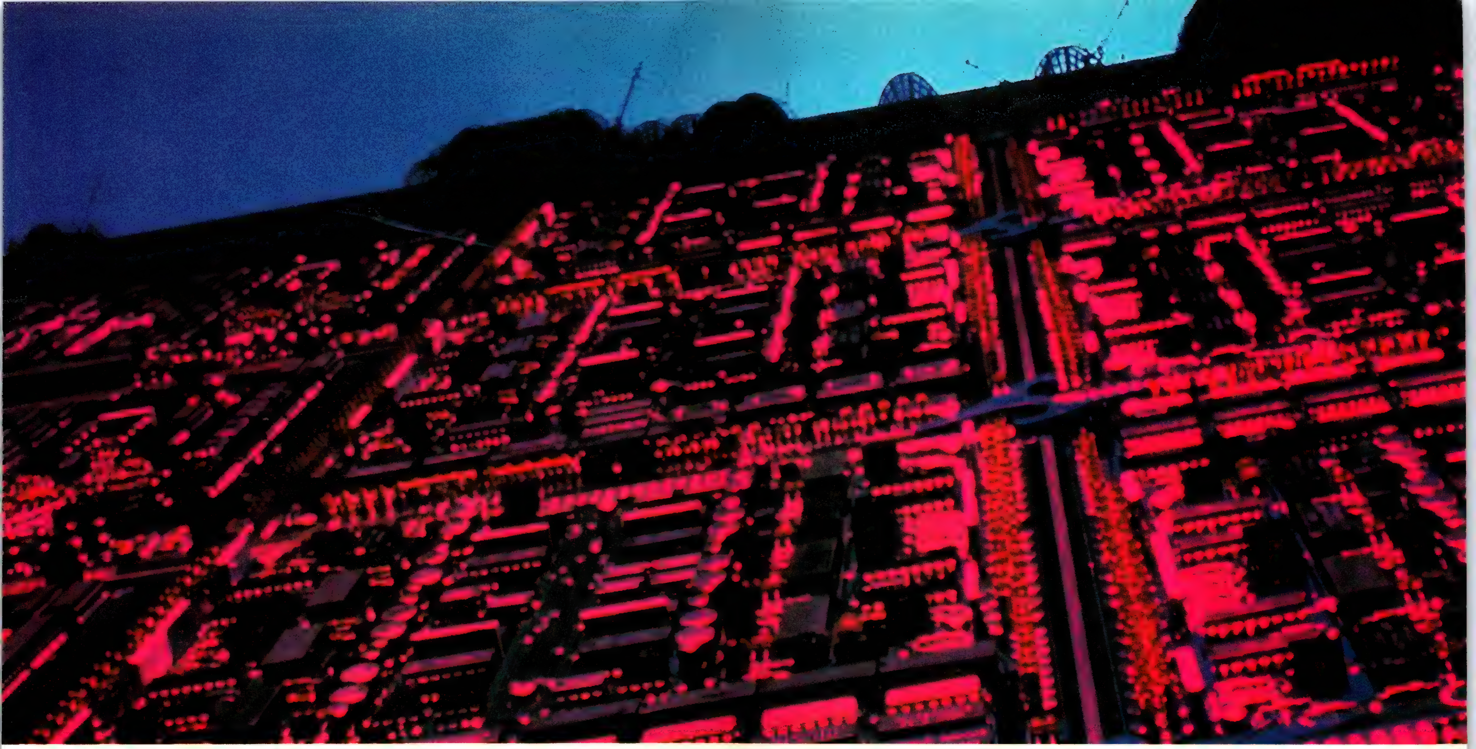
There are a couple of new keyboard technologies that may soon be gaining designers' attention. One of these new types is the inductive keyboard, in which the switching is done by a piece of ferrite material that moves through a hole on the pc board. When the ferrite core enters the hole, a transformer coil that is printed on the board around the hole senses the change in inductive coupling and then sends out the necessary signal.

Another approach derived from basic electronic principles is the capacitive keyboard. Here, the key movement causes a capacitive change in a circuit, which serves as an indication that a key was depressed.

Yet another technology that may find its way into the hearts of designers is one based on optics. Sure to provide all of the advantages of fiber optics, plus cut down on bounce, the optical keyboard works much like the light beams that keep elevator doors open as people enter and leave. In this approach, the key movement breaks a light beam and its associated detector sends out a signal.

The Pushbutton World

Pushbutton switches may be the broadest subcategory of the switch universe. Although performing in such wide-ranging uses as telephone sets, data keypads, keyboard switches on data-entry terminals, and membrane switches, pushbutton switches can be grouped into two categories: general-purpose and low-level. Moreover, these two groups can be further divided into



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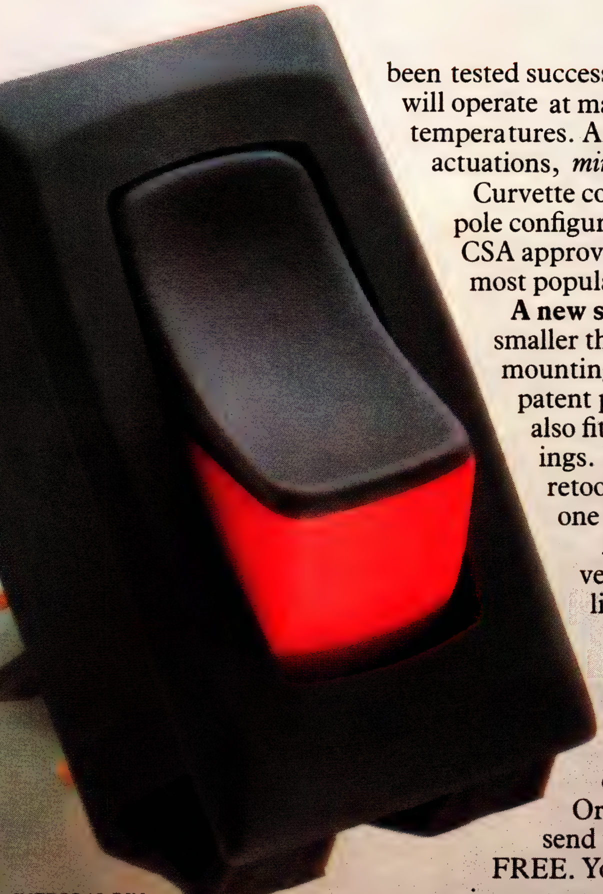

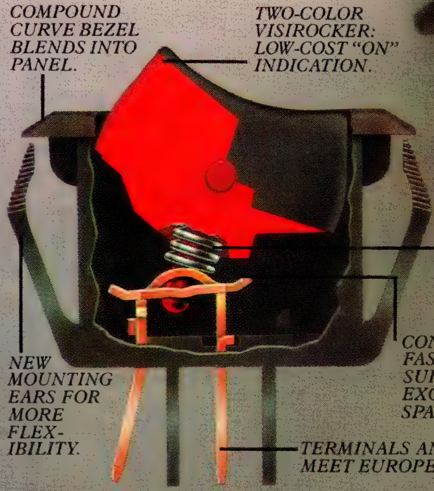
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INTEGRAL PIN DESIGN: SPRING CREATES CONTACT PRESSURE, DISSIPATES HEAT.
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CARLINGSWITCH
INNOVATION BY DESIGN

Circle 184 on reader service card

lighted and nonlighted models.

General-purpose switches are those typically used in on/off functions in electronic test equipment, machine tools, various industrial control equipment and process control, as well as in medical diagnostic instrumentation.

Low-level switches are those in which the manual input provides commands for a logic circuit. They have ratings of 5 V and currents of a few milliamperes. In contrast, general-purpose pushbuttons are rated at 250 V at 5 A.

Electronics' World Market Survey estimated that the 1984 market for pushbutton switches would be $94.3 million, rising to $109 million in 1987. This healthy market has led to steady technological advance.

Today, the major concerns driving pushbutton-switch technology are how to handle what are called dry circuits (low-level logic of 5 V or less); miniaturization; a new lighting source; and the push for standardization.

In dry circuits, conventional silver contacts may not be able to provide reliable service for the low-level signals. This problem is being handled in a number of ways.

Three Solutions

One is the use of a Hall-effect device. Here, the pushbutton does not do the actual switching: rather, the actuator lowers a small permanent magnet close to a Hall-effect device that trips due to the magnetic field. Hall-effect switches are free of bounce, are fast, and boast an indefinite life span. They are more costly, however than other solutions to the dry-circuit problem.

A second method of dealing with low-level logic is by using standard silver-contact pushbuttons with gold plating over the silver. The thin gold layer solves the problem without requiring tooling changes. The additional cost is due merely to the gold.

The third common way of dealing with dry circuits is by using nonsilver contacts with gold plating. This method requires substituting new contacts for the traditional silver ones and modifying the overall mechanism. With new tooling involved, these steps add to the cost.

In either the second or third case, care should be taken not to expose the contacts to destructively high voltages and currents, either during operation or by excessive testing during inspection.

Shrinking Switches

Not only is the rush to microprocessor-based equipment calling on switches to perform at lower voltage and current levels, but it is demanding that switches become smaller and smaller. In response, switch manufacturers are developing new tooling, new materials, and new switching mechanisms.

This opportunity will also allow manufacturers to design a permanent solution to the dry circuit, since gold contacts is seen by many as a barely satisfactory solution. The factors that make a switch a good performer—sliding, wiping action, contact pressure, and snap action—all contribute to destroying the gold contacts and reducing switch life.

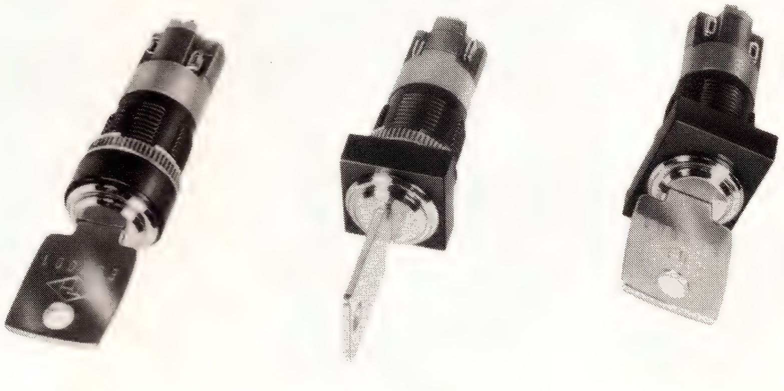
In terms of lighted pushbuttons, switch manufacturers would relish finding another source than incandescent lamps, which require a moderate amount of power, may be too hot for many applications, and come in too few types. However, the alternative sources to date have fallen short. Light-emitting diodes, for example are not bright enough and come in only three colors.

Incandescent lamps' biggest fault is the limited number of bulb types. Pushbutton manufacturers do not want to specify a custom-made bulb out of fears that other switch manufacturers would not follow suit and that purchasers would find replacement bulbs were not readily available. Bulb makers, however, will not create a new type unless they are sure there is a ready market for it.

This leads to the last force molding the switch marketplace: standardization. Although there has been some attempt at creating a interchangeable switch, there is not much progress to report. The benefits to switch purchasers would be easy and plentiful second sourcing, lower prices due to the intensified competition, and quite possibly, a reduction in costs of assembly and inventory.

"Looking into the future, there isn't much more that can be expected from pushbutton switches in terms of electrical performance," says Joseph Santoro, general sales manager, for Unimax Switch Corp., of Wallingford,

These two-position key-operated switches from Unimax Switch Corp. for medium-security applications are designed to prevent unauthorized use or interruption of equipment. The Wallingford, Conn., firm has models with one to four poles, and maintained or momentary action (the latter having no detent position so it snaps back). [Circle 464]



Conn., a large manufacturer of lighted and unlighted pushbutton switches. "Today's 5 A at 250 V ac is quite adequate for a general-purpose pushbutton. Also the 1-million-cycle life is quite adequate. Chances are that the switch will outlive equipment it is serving."

The World of Rotaries

Discrete rotary switches, a mature technology, are still the best way to control multicircuit functions. According to *Electronics* World Market Survey, the rotary switch market for 1984 is estimated at $126 million and will go to $162 million in 1987. Like keyboards, rotary switches are finding increased uses, due to the proliferation of microprocessor-based equipment.

Rotary switches can be grouped into two categories: enclosed and open-frame. All of the criteria by which to evaluate switches in general—contact resistance, load rating and type of load, life, dielectric strength, voltage and current handling, and so on —apply to rotaries as well. But there are a few additional considerations in selecting a rotary switch: size, shaft and bushing lengths, number of poles, number of positions per pole, number of decks, and torque.

Rotary segments can produce virtually any desired electrical pattern. That attribute, combined with the ability to gang several decks on a common shaft, provides high switching versatility in a single compact package. The number of positions, or steps, can be varied to suit specific applications. Many manufacturers of rotary switches including Oak Switch Systems Inc., Crystal Lake, Ill.; Ledex Inc., of Vandalia, Ohio; Cole Instrument Corp., of Santa Ana, Calif.; Armtec Industries Inc., of Manchester, N. H.; and Grayhill offer standard switches with 8, 10, 12, 18, 20, and 24 stations.

For a rotary switch, torque is analogous to actuating force: it is the force required to rotate the switch through the various positions. This force is specified in terms of maximum and minimum values, whose average is measured during qualification testing. A manually operated switch should present a steadily increasing resistance as it is moved out of each position and a smooth positive tactile feel as it snaps into the next position.

During the operating life of the switch, rotational torque may drop, due to wear on detent sprockets and relaxation of springs. It may be desirable to specify a minimum end-of-life value; if so, a rule of 50% deviation from initial torque value is often the specification.

Torque plays a role in the switch designer's decisions on the mounting bushing and on stop strength. Generally, the better stabilized the switch is in its mounting surface, the better it will withstand lifetime torquing forces. The switch should incorporate firm and secure mounting means. Stop strength should be adequate to withstand torque force of 25 in.-lb for switches 1⅛ in. and larger, 15 in.-lb for switches from 1⅛ to ⅝ in., and 7½ in.-lb for smaller switches.

Finally, the number of switch decks, poles per deck, and positions has a direct effect on the torque needed to provide a positive detent action. Larger switch assemblies (those with more decks) should have adequate longitudinal support for the mass of the switch and associated wiring.

Some Subcategories

One subcategory of rotary switches gaining popularity as computers and computer terminals move out of the data-processing center and infiltrate the front office is keylock switches. They permit operation of the switch by authorized personnel only. In most cases, the keylock switch mounts nearly flush to the panel and is secured by a nut from behind. Its mounting prevents the keylock switch from being loosened or removed from the front.

A spring-return rotary switch is one in which a rotational force, applied to the shaft, is required to maintain contact at one or more switch positions. Releasing the force on the shaft allows a spring mechanism to return the contact to the desired position, known as the detent position.

An isolated-position rotary switch is

Two tiny LEDs in the tip of this toggle switch change color, depending on the position of the switch. This part, from NKK Switches of America Inc., of Scottsdale, Ariz., lets designers eliminate independent LED indicators and thereby save panel space. The switch's light can be seen in an arc greater than 180°. [Circle 466]

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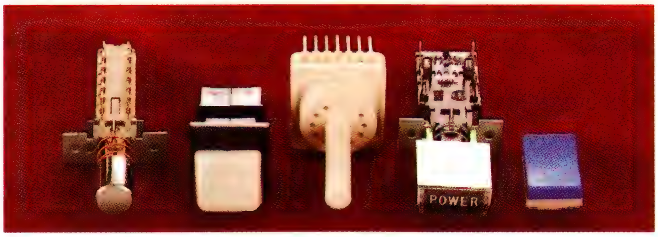

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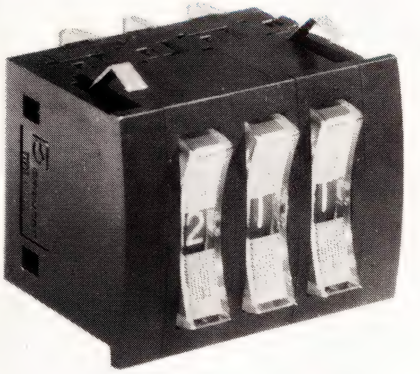

This snap-in rocker-actuated digital switch from Crouzet Controls Inc., Schaumburg, Ill., is easy to assemble in equipment panels: no tools or hardware is required. Capable of handling from 0.1 to 250 V ac or 0.1 to 50 V dc, the switch features large LED readouts. The 6-mm numerals are easy to read. [Circle 465]

one that cannot be turned to or from a predetermined position by the normal rotation of the shaft. An additional action, like pushing in or pulling out on the shaft, is required from the operator before the switch can be turned to or from the isolated position.

The last subcategory is coded rotary switches. They are used for converting decimal to such computer codes as binary-coded decimal and octal.

Of Thumbwheels and DIPs

Thumbwheel switches, sometimes called digital switches, and switches in dual in-line packages generally serve one purpose: to convert decimal inputs to binary inputs. Thumbwheel switches are found on the front panels of various pieces of equipment, and DIP switches are usually found tucked away deep inside circuitry that is mounted on pc boards.

DIP switches are generally used to reprogram circuitry on the pc board. They are facing hot competition from erasable programmable read-only memories and electrically erasable PROMs, in which the alterable circuitry is, in effect, reproduced in software. Still, the continued healthy state of keyboards and solid-state technology in general is producing an 8% annual growth rate. According to Frank Bruder, product manager at Eeco Inc., Santa Ana, Calif., this growth rate is quite respectable for a mature technology.

Electronics World Market Survey pegged the 1984 market for thumbwheel switches at $30 million and DIP switches at $66 million. Bruder's estimate for 1984 is at $26 million for thumbwheel switches.

"Still, the thumbwheel switch's ability to convert decimal inputs to binary outputs and its compactness of design, as well as various other operational and performance characteristics, will assure application niches in industrial and military markets," Bruder says.

Simple Construction

The construction of most thumbwheel and DIP switches is quite similar and simple. A basic switch consists of a plastic rotor with a printed alphanumerical legend, brush contacts, a pc board, a detent spring, and a housing. The housing, rotor, and thumbwheel are generally molded plastic.

The pc board inside the housing has tracks to make contact with the switch and an output terminal connection. Usually, the board is fixed to the housing, and the brush assembly rotates as it is driven by the pushwheel. The digital code output of the switch is determined by the unique track patterns on the pc board. The brushes connect sections of the track pattern as the switch actuator is moved from one position to the next.

Together, toggle, rocker, and paddle switches make up 23.6% of a total switch market of roughly $600 million. These well-known switch types are found nearly everywhere.

As a rule of thumb, toggle switches fall into one of four sizes: standard, which are more than 2 in. high and have current ratings of 1 to 50 A; miniature, less than 2 in. and 0 to 15 A; subminiature, 1¼ in. to 1½ in and 0 to 6 A; and ultraminiature of less than 1¼ in. and rated to 2 A.

A quick glance at the recent toggle offerings from the top manufacturers shows the preponderance of them to be smaller than their predecessors. Both unit and dollar sales for smaller switches are rising. By 1986, the shipment of miniatures is expected to register an annual 22% increase, while sales revenues will probably climb at a 6.3% annual rate.

By contrast, demand for the larger toggle switches will continue declining, although the total dollars spent on these designs are expected to continue to increase, mostly due to rising prices. By 1986, the number of units shipped is expected to drop by about 9%, while the average price is projected to move up about 33%.

Some Competition

Although demand for toggle, rocker, and paddle switches will continue to increase over the next couple of years, their share of the total market for switches is not expected to remain at its current 24% level. The reason suggested is that those designs, particularly toggle designs, used in traditional on/off applications will be steadily displaced by pushbutton or rocker switches.

The decline will be partly offset, however, as the spread of electronics applications boosts the need for miniature and ultraminiature toggle, rocker, and paddle switches mountable on pc boards. In fact, the growing need for board-mountable designs, particularly dry-circuit switches, is making manufacturers come up with more reliable parts. New logic-level switches with self-wiping or cleaning contacts are just one of the examples.

All three of these switch types will have less precious metal in the contacts. Inlays and selective plating are two common methods for replacing gold and silver.

Washability for any switch mounted on a pc board will also become an important feature. The strong interest in washable devices derives from their ability to be wave-soldered and then cleaned of flux without fear of contact contamination.

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Annunciator: an indicator or action that requires a response; in this context, usually prompted by a light on the keyboard.

Alternate-action switch: a unit that remains in a given condition until actuated by an operator into another condition.

Bounce: rapid and unwanted rebounding of a contact after closing, usually measured in either microseconds or milliseconds.

Contact chatter: intermittent closure of open contacts or opening of closed contacts resulting from contact impact.

Double break: a contact arrangement where the moving switch element bridges across two fixed contacts so that the circuit is broken in two places simultaneously. Also called shorting bar.

Double-pole, double-throw: a switch that makes and breaks two separate circuits. Each pole has a normally open and normally closed contact.

Dry circuit: very low-energy circuit, usually less than 5 V and 10 mA. Its operation is commonly in the microampere and millivolt ranges.

Emi/rfi shield: a shield that is used to protect a keyboard's operation from electromagnetic and radio-frequency interference.

Full-travel: a switch travel that has both a pronounced pretravel and overtravel.

Grass: variation in contact resistance viewed on an oscilloscope, following contact bounce and before switch contacts are settled.

Living hinge: a hinge injection-molded as an integral part of the key and bezel.

Low-level circuit: low-energy circuit, usually in the 5-to-12-V, 10-to-100-mA range. See also dry circuit.

Maintained contact switch: an alternate-action switch.

Momentary-action switch: A switch that returns from the operating condition to its normal circuit condition when its actuating force is removed, usually by a human operator.

Overtravel: The distance that the plunger of a switch is driven past the

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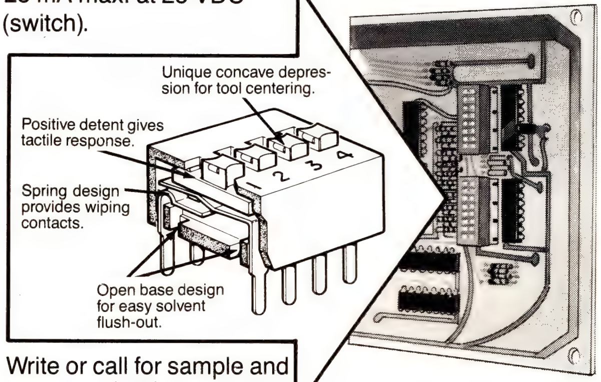
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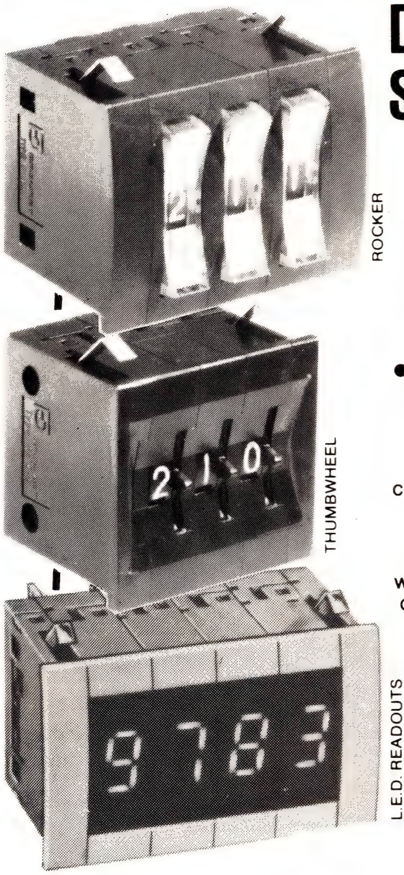

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operating point when actuated.

Poles: the number of completely independent circuits that are built into a switch; that is, a single-pole switch controls one circuit, and a double-pole switch controls two circuits, and so on.

Pretravel: the distance through which the plunger of a switch moves from its free position to the operating point.

Shorting bar: see double break.

Single-pole, double-throw: a switch that can either make or break a circuit, having one common and both a normally closed and a normally open terminal.

Single-pole, single-throw: a switch with one common and with a normally closed or a normally open terminal.

Sliding action: Where contacts slide over one another resulting in a continuous self-cleaning of the surfaces, which helps insure low contact ~~resis~~tance. Same as wiping action.

Snap-action switch: a switch with an audible or tactile feel or both when actuated.

Snap-dome switch: a stainless-steel disk that snaps over the contact traces on a printed-circuit board. When depressed, it makes contact with the trace.

Static shield: a device that protects internal circuits from static-discharge damage.

Tactile feedback: the over-center sensation of a snap-action switch as felt by the operator.

Throw: the number of circuits that each individual pole of a switch can control. Also, the movement of a contact from one stationary point to another.

Total travel: the sum of pretravel and the overtravel.

Trip force: force required to cause the snap dome to actuate.

Two-circuit switch: in one position, contacts complete one circuit; in the other position, contacts complete a separate circuit after opening the original circuit.

Wiping action: same as sliding action.

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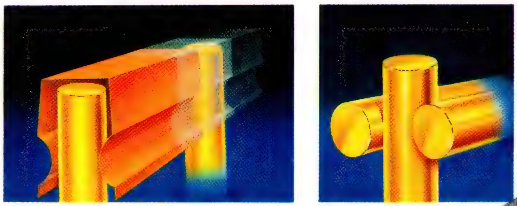

GOLD-PLATED SLIDING TWIN CROSSBAR CONTACT PRODUCES SMOOTHER OPERATING ACTION AS WELL AS UNMATCHED RELIABILITY.

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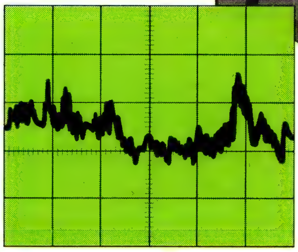

Until now, design engineers have found it difficult to create smooth operating, highly reliable switches within the framework of sliding contact technology. However, by utilizing "round" stationary and common contact points (U.S. Patent No. 4371767), NKK's STC produces an exceptionally smooth operating feel. In fact, traditional non-STC contact mechanisms can cause an ON-NONE-ON condition in what is suppose to be an ON-OFF-ON switch. This possibility is precluded by the sophistication of NKK's STC design.

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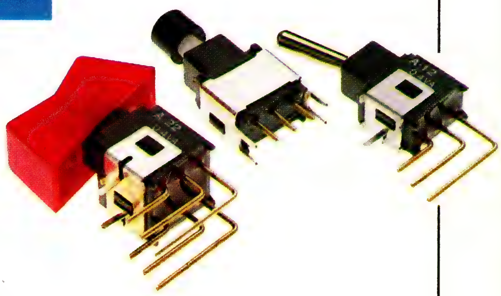

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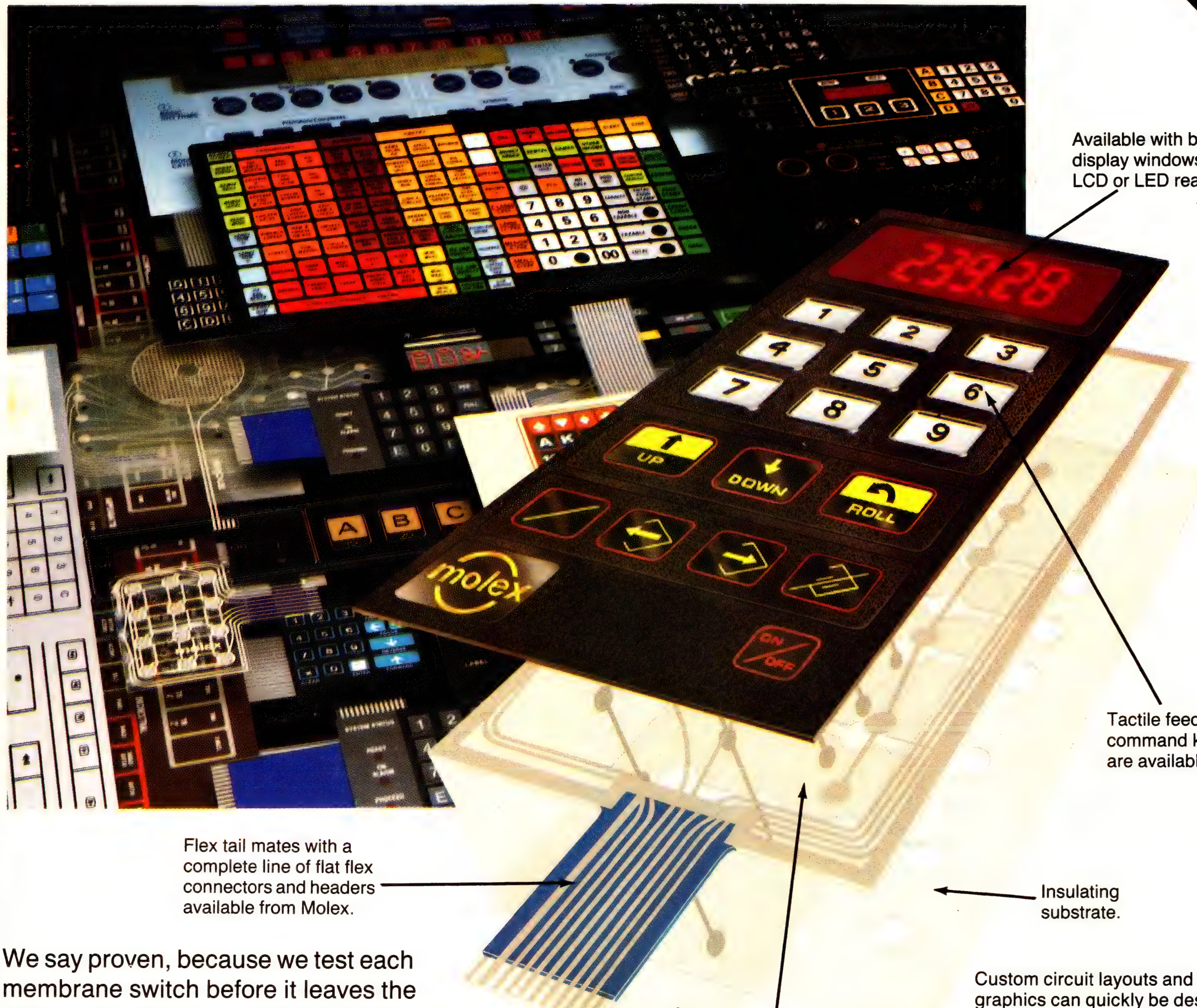

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For the easy connection of membrane switches into your product Molex offers a variety of flat flex connectors. And for your other component needs, we offer a range of connectors and cable products, as well as audio-transducer mounts that audibly confirm switch activation.

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New product previews

Introducing noteworthy hardware and software

Set of tools builds graphics software

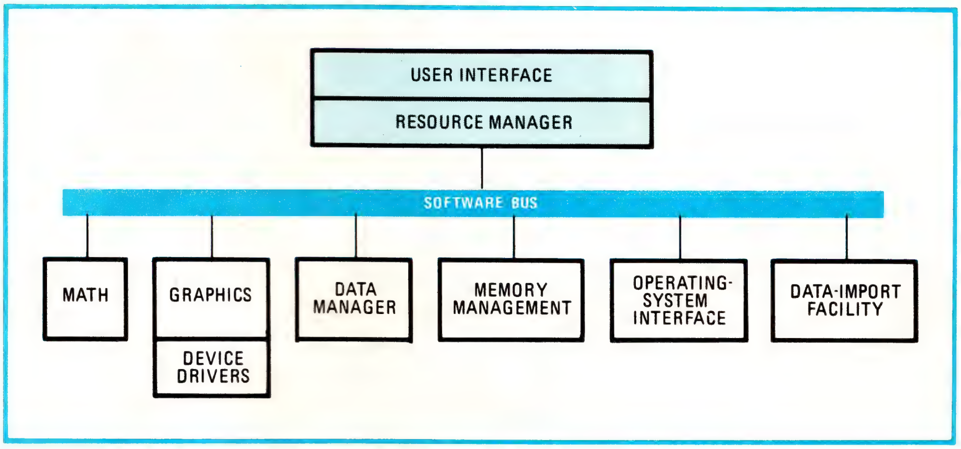
Machine-independent modules linked by a software bus build easy-to-use, customized graphics application packages

by Jeremy Young, Software/Microsystems Editor

A family of software modules called the Business Graphics Application package provides application designers with a set of tools to write custom software that offers the end user versatile and easy-to-use presentation-graphics facilities. Available for use under Microsoft's MS-DOS and AT&T Bell Laboratories' Unix operating system, the machine dependencies of the BGA software have been carefully localized for portability.

Tying the family of modules together is a resource manager and what the manufacturer, Brag Systems Inc., calls a software bus, which acts rather like the kernel of a real-time operating-system executive, according to the firm. The modules can be enhanced to be independent, reentrant, and data-table driven, which makes them better able to take advantage of multitasking and distributed-processing environments. Each module runs separately from the others and can be used concurrently by several jobs, responding to data tables as input packets.

The application designer can use the modules by writing program files containing "scripts," a series of operations to be performed repetitively upon the designated data. The kernel module controls the execution of these scripts and also maintains lists of recognized objects, such as circles or polylines, and instructions, such as "save" or "restore."



All aboard. Brag Systems uses a resource manager and what it calls a software bus to tie together the individual graphics modules. Each module can run separately.

A memory-manager module has charge of both system and user data, acting as a gateway to get the right data to the right modules and providing dynamic storage allocation in the system, including demand paging for virtual memory, if needed.

Machine-specific. A module called the Operating System Interface handles machine-specific tasks and provides the other modules with a uniform interface that masks out the peculiarities of the system they are running on. Input and output to the host's filing system, the user's screen and keyboard, and other hardware parts are among this module's responsibilities.

The Operating System Interface has a set of standard primitives that must be recoded to bring up the BGA package on a new machine. According to Brag Systems, a preliminary working system can be implemented in about three days and a fully operational system in two to three weeks. Device drivers must also be written for each unique graphics peripheral—cathode-ray tubes, plotters, printers, high-resolution film recorders, and so on—to be used for the system's output.

One of the major features of the BGA package is its data-management module, which is complemented by a data-import facility. This data-base manager is optimized to handle the binary tabular data files used by the graphics modules and makes it possible for designers to give their software the ability to create local data bases from external files for the purposes of local data manipulation, analysis, and reporting.

English-like. Instructions executed by the data-management module can be used to build a nonprocedural English-like query language similar to IBM's SQL. Or a menu mode can select and sort data for passing to the user-interface module. The data-import facility currently can read files generated by the Multiplan spreadsheet program; modules are being developed to translate the DIF files used by VisiCalc and other programs, as well as to interface with Oracle and Ingres data-base managers.

The actual graphics-output module is used to create and manipulate images. These are created by the application of high-level graphics instructions—specifying such things as size, magnitude, orientation, and color—to data objects retrieved from the data base. Both the instructions and the image files they create are machine-independent.

More than 130 functions are available for creating charts—more than one per screen, if desired. Users are given extensive control of axes, grids, and curve parameters; they can load their own format or font files. An editing facility allows the user to embellish images and create free-form images, such as logos.

The user-interface module translates commands and data that users enter and manages the display up to the final graphic output. Icons and pulldown windows can be provided in an interface that uses a mouse or another pointing device. The system includes facilities for on-line help, tutorials, and glossaries that can be customized for applications.

Brag Systems asks for a customer commitment to an annual fee of $250,000 and royalties on product sales of about 20% of suggested retail (about $800 for the charting, graphing, and data-based software together). The BGA modules are available now.

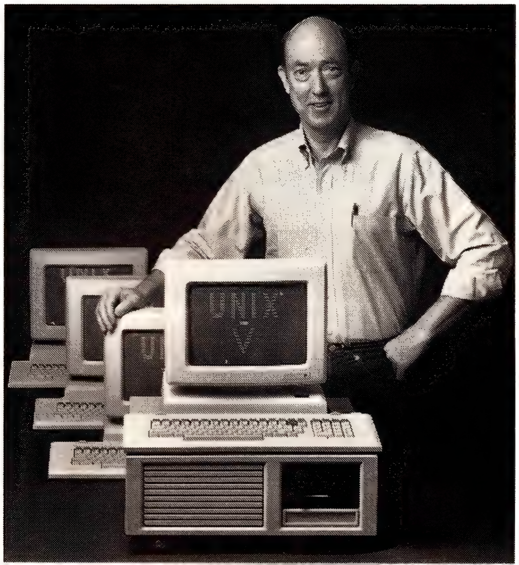
Brag Systems Inc., 800 S. Claremont, Suite 209, San Mateo, Calif. 94402. Phone (415) 342-3963 [Circle reader service number 338]

68000-based microcomputer provides a Unix system for less than $2,500 per user

Bowing this week at the National Computer Conference is Tricep, a personal computer based on a version of AT&T Bell Laboratories' Unix System V operating system. Prices for Tricep, which uses the 68000 microprocessor and supports four to eight users, will start at less than $9,000 retail and less than $5,500 in original-equipment-manufacturer quantities. That means a cost per user of less than $2,500.

The system will be available in August. According to Robert Dilworth, Morrow Inc.'s president, it represents the company's aggressive entrance into the OEM-system-integrator market as well as an effort to strengthen Morrow's traditional distribution base of mass-merchandise retailers.

Optional slave-processor boards based on the 80188 central processing unit and running the MS-DOS operating system will be added in September. Tricep's hardware includes a 10-MHz 68000 with an on-board 69451 memory-management unit, 512-K bytes of memory (expandable to 2 megabytes), an input/output controller with four RS-232-C ports (expandable to eight), a parallel port, and direct-memory-access controllers for hard- and floppy-disk drives. All boards, including the optional slave processors, plug into the 14-slot S-100 backplane.



Added features. The system's mass storage includes from one to four 16- or 34-megabyte 5¼-in. Winchester disk drives—a maximum of 136 megabytes—as well as an optional 5-megabyte removable-cartridge disk drive, from one to four 400-K-byte 5¼-in. floppy-disk drives, and from one to four 1.3-megabyte 8-in. floppy-disk drives.

Dilworth says that Tricep's Unix System V port, licensed from Unisoft Systems and fully compatible with Bell Laboratories' System V, has such enhancements as record-locking and floating-point capability. An optimizing C compiler comes with the system; other available programming languages include Basic, Cobol, Fortran, Ada, and Pascal.

Tricep's serial I/O controller communicates with terminals and printers at rates of up to 19.2 kilobaud. The unit's hard-disk controller features a seek time of 85 ms with the standard 16-megabyte drive or 35 to 45 ms with the optional 34-megabyte drive. Data-transfer rates go up to 625 kb/s.

The slave processor boards, which will sell for $700 each, are designed to relieve the main CPU of application tasks and to further expand the system's application base to include the wide range of available MS-DOS software.

Morrow Inc., 600 McCormick St., San Leandro, Calif. 94577. Phone (415) 430-1970 [Circle 341]

32-bit 68020 sustains 3 MIPS

Come later this year, 100 customers will be added to the select list of those who already have the long-heralded 68020, Motorola's 32-bit microprocessor. The company recently announced that the 68020 is in production—manufactured with a 2-μm HC-MOS process that integrates some 200,000 individual transistors on a 375 by 350 die packaged in a 114-lead pin-grid array.

The MC68020 processes instructions at a sustained rate of 2 to 3 million instructions/s and burst rates that can exceed 8 MIPS. The company claims that this is 2.5 times the performance of any available processor on the market today. The processor operates at a 16.67-MHz clock frequency (60-ns clock period), dissipates less than 1.5 W, and is object-code compatible with earlier members of the 68000 family. The company says that the part is the first true

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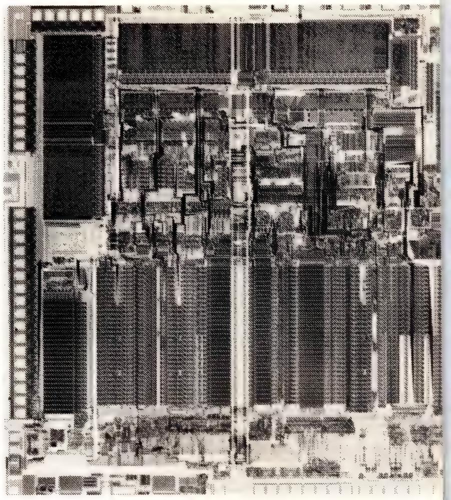

32-bit design—one that includes nonmultiplexed 32-bit internal and external data and address paths, all 32-bit registers, 32-bit arithmetic and logic units, and 32-bit program counters and stack pointers.

Cache. The 68020's full 32-bit design structure provides for direct linear access to four gigabytes of logical memory and eliminates instruction timing differences for byte, word, and long-word operations. The chip features a 256-byte instruction cache that allows simultaneous data and instruction accesses and execution, as well as overall improvement of the system's performance.

The company is also making available cross-development support on either the EXORmacs multiuser development system or the VME/10 microcomputer system. Samples of the processor will cost $487 each.

Motorola, Semiconductor Products Inc., P. O. Box 20912, Phoenix, Ariz. 85036. Phone (512) 440-2139 [Circle 401]

Controller builds nonimpact printers

Designers wishing to build a flexible nonimpact printing system can do so with the Pixel 300, a 68000-based intelligent controller. For use with laser and ion-deposition printers, the controller is built around the VMEbus and can accommodate various print engines that can handle from 8 to 60

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pages/min. The Pixel 300 has an open-system architecture, can be interfaced to most word-processing systems, and offers an unlimited number of type fonts that can be downloaded from the host system.

According to Larry B. Harvey, president of Electronic Machine Corp., "Our intelligent controller has been designed to provide original-equipment manufacturers and systems integrators with an open-system approach which provides the most comprehensive line of system products to support nonimpact printers."

The controller uses the 68000 processor to accept data from the host computer or word processor through an RS-232-C serial or parallel port. The processor then instructs the direct-memory-access controller to use the characters from its font memory to compose the input data on a bit map, which is located on a video board. It is the board that puts out the bit map in a raster mode to the laser printer.

The open-system architecture facilitates a number of additional capabilities. For example, a full-page bit map is possible with an additional 1 megabyte of memory. And higher printing speeds can be obtained by using multiple video boards and merging their raster outputs to the laser printer. A Z80A interface board provides four RS-232-C serial and two parallel ports; the parallel ports permit the printer to interface with five or more word-processing systems or host computers with print-code conversion and protocol recognition.

OEMs can order the controller system configured to two levels of performance—8 pages/min and 18 to 60 pages/min. This rate can be sustained because the controller can transfer a 4,000-character (32-by-50) full-page graphics bit map in 0.6 s. In a standard configuration with three boards for the 18-to-60-page/min printers, the Pixel 300 will sell for about $3,000 in lots of 500 or more. Controllers will be available in the third quarter of the year.

Electronic Machine Corp., 417 S. Hill St., #500, Los Angeles, Calif. 90013. Phone (213) 687-9681 [Circle 340]

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Computer-aided design

32-bit station does routing, rule checking

The model 42 MultiTasker, a 32-bit off-line multitasking work station for autorouting and design-rule checking, performs as an additional node on Paragon Technology's series 300 network system or as an off-line work station compatible with the firm's 100A and 200A printed-circuit-board-design graphics work stations.

The MultiTasker consists of a console with a keyboard and a VT100-type terminal. Its memory capacity is 512-K bytes and the system also includes three serial ports. The console accommodates an 8-in. floppy-disk drive as well as a 20-megabyte Winchester disk drive and a controller.

The unit can be used for off-line control of a model P-20 photoplotter. Output to automated-test and automatic-insertion or wirewrap equipment is standard.

Available within 30 days of order, the Model 42's unit price is $30,000, with autorouting optional at $2,500. Other options include a modem, a paper tap punch, the model P-20 photoplotter, a penplotter, a magnetic tape, a line printer, and an uninterruptible power supply.

Paragon Technology Corp., 2199 Norse Dr., Pleasant Hill, Calif. 94523. Phone (415) 676-4741 [Circle reader service number 421]

Hard-disk drive, digitizing tablet enhance design system

The 8510/10 monochrome and the 8600/10 color systems for computer-aided design and drafting have been enhanced with the addition of an integral 10-megabyte hard-disk drive, a 15-in. monochrome monitor, a 12-by-17-in. digitizing tablet, and a low-profile, adjustable keyboard.

The increased storage capacity of the systems, which are already configured with a 1.2-megabyte floppy-disk drive, lets users store additional drawings and schematics in a single system.

With a resolution of 640 by 480 by 2 bits, the monitor's viewable area has been increased by 156%. The digitizer is used for command input to the company's DesignPro professional and Mini-Draft educational systems for computer-aided design and drafting. It also includes menus for mechanical, electronic/electrical, and other computer-aided-design-and-drafting applications.

Prices for the systems start at $12,500, including software for three-dimensional applications. Both are available now.

Terak Corp., 14151 N. 76th St., Scottsdale, Ariz. 85260. Phone (602) 998-4800 [Circle 422]

Split-screen systems display physical, logical designs

Integrating everything from schematic entry to pattern generation, Phoenix's VAX-based work stations let users view logical and physical designs simultaneously on split screens.

Software tools that come with the work station provide for schematic capture, logic and circuit simulation, waveform analysis, physical design, and layout verification. The software is also designed to run on DEC's MicroVAX and VAX-11/725 computers in a turnkey operation. Alternatively, the work station can be purchased in a graphics-display-only configuration that is supported directly by a VAX computer.

Available 90 days from receipt of order, the basic system costs $44,900 and includes a MicroVAX I computer with one Tektronix 4109 color-graphics terminal and systems software. For two terminals, the price is $60,900, and for three, $76,900.

Phoenix Data Systems Inc., 2700 Augustine Dr., Suite 200, Santa Clara, Calif. 95054. Phone (408) 988-8804 [Circle 423]

Three engineering programs can share common data files

Three stand-alone engineering software programs for circuit analysis, graphing, and signal processing, respectively, can share common data files. Acnap, an ac network-analysis program, analyzes electronic circuits consisting of resistors, capacitors, inductors, and such components as operational amplifiers.

Plotpro is a scientific graph-printing program that makes linear, log, and semilog graphs on an 80- or 132-column printer and also makes horizontal and vertical graphs with up to two independent Y axes. SPP is a signal-processing program that analyzes linear and nonlinear systems in the time and frequency domains.

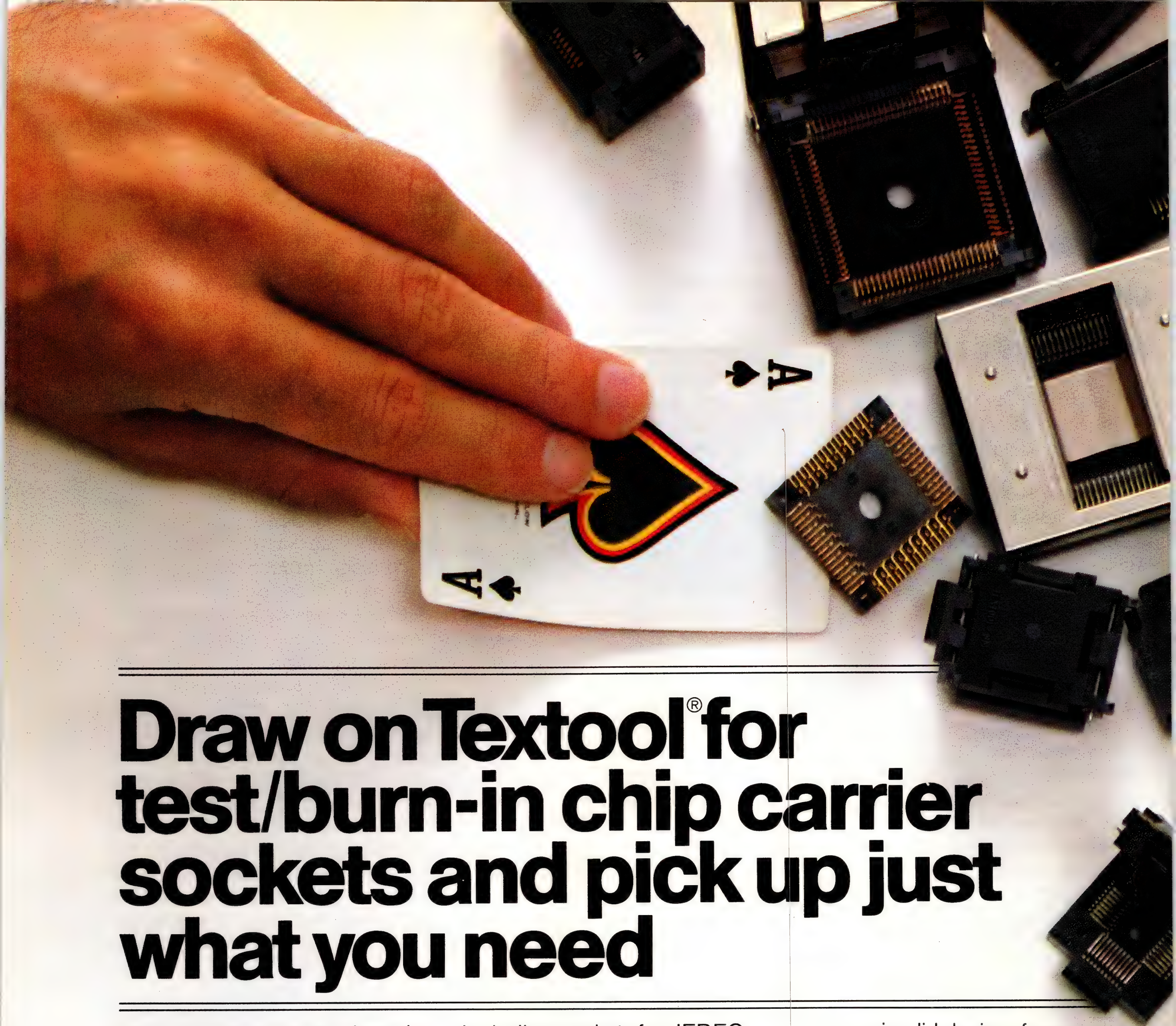
All the programs are available now for use with the CP/M, MS-DOS, TRSDOS, and PC-DOS operating systems. Acnap and Plotpro cost $49.95 each; SPP goes for $59.95.

BV Engineering, P. O. Box 3429, Riverside, Calif. 92519 Phone (714) 781-0252 [Circle 424]

Hardware speeds, improves IC design-rule verification

The Fast-Mask Engine, a hardware option for Calma Co.'s Graphics Design System II, offers speed and performance improvements for integrated-circuit design-rule verification. The Fast-Mask processor-based system has 750-K bytes of memory and an 80-megabyte Winchester disk. A direct line from Fast-Mask to the System II provides transparent on-line operation. The unit is available now at prices beginning at $60,000.

Calma Co., 2901 Tasman Dr., Santa Clara, Calif. 95050. Phone (408) 748-9600 [Circle 426]



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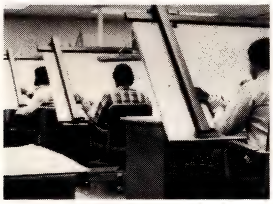

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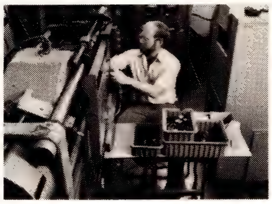

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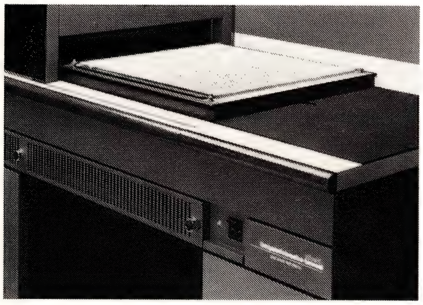
Instruments

Fixture lets tester handle various boards

A bare-board test station features universal grid fixturing, which adapts a single bed-of-nails tester to any printed-circuit board. However, the board must be within the test station's size requirements.



Other features of the test station include the ability to self-learn test programs from boards that are known to be good specimens, and a color video-display terminal. The station sells for $150,000 and up, depending on configuration requirements.

Computer Automation Inc., Industrial Products Division, 2181 DuPont Dr., Irvine, Calif. 92713. Phone (714) 833-8830 [Circle reader service number 351]

Subsystem for HP 64000 emulates the Intel 8051

An emulator for the Intel 8051 microcomputer, the HP64264S, is now available as a subsystem for the HP 64000 system, a universal development system. The 64000 can support the 8051 processor with full emulation and provides access to many user-transparent functions.

The nonintrusive emulator runs at 8051 operating speeds up to 12 MHz, providing an execution environment for testing and modifying hardware and software during development.

In addition to typical emulation capabilities, the 64264S has special features to support distinctive 8051 functions. For example, the emulator supports the tracing activity of the internal data memory, the accumulator and other special-function registers, and all four input/output ports.

Priced at $5,400, the emulator subsystem is available 10 weeks after ordering.

Hewlett-Packard Co., Inquiries Manager, 1820 Embarcadero Rd., Palo Alto, Calif. 94303 [Circle 352]

Fiber-optic-cable test source comes in popular wavelengths

A portable light-emitting-diode source for use in testing fiber-optic cables, splices, and connectors is available in all popular wavelengths, including 665, 820, 880, and 1,300 nm; 1,550-nm LED sources are available on special order.

The model 5300 uses a stable drive circuit to drive the LED and has rechargeable batteries for use in the field. The LEDs are standard devices similar to those used in many fiber-optic communications systems.

Single-mode pigtailed chips offer up to 5 μW of optical power output, adequate for testing losses of 20 to 30 dB on single-mode fiber links, when used with conventional fiber-optic power sources. Long-wavelength multimode sources have up to 50-μW power outputs, which allow testing losses of 30 to 40 dB.

The model 5300, which is priced from $450 to $2,200 depending on light source, is available four weeks after receipt of order.

Fotec Inc., 560 Harrison Ave., Boston, Mass. 02118. Phone (617) 542-1719 [Circle 354]

Automatic system tests telecommunications, audio ICs

Equipped with new digital instrumentation modules and a distributed-processing architecture, the A360 analog large-scale-integration test system has been reconfigured to measure the quality of integrated circuits in telecommunications and audio products. The A360 Telecommunications Test System can handle such complex gear as single-chip modems and pulse-code-modulated dialers.

For high-volume testing, the A360 offers the M634 array-processor module, an option that processes digital signals. The system can also be outfitted with another array processor, the M630 audio-signal-processing computer module, which provides custom algorithm-design software and an interactive graphics package for more complex digital signal-processing applications.

Available 20 weeks from receipt of order, the system is priced from $150,000 to $310,000, depending on the configuration.

Teradyne Inc., 321 Harrison Ave., Boston, Mass. 02118. Phone (617) 482-2700 [Circle 353]

Passive parts tester performs 50 measurements/s

A programmable microprocessor-based instrument can perform up to 50 resistance-inductance-capacitance measurements/s. The 1689M, the latest addition to its maker's Digibridge line, is suitable for production testing of resistors, capacitors, and inductors, as well as for incoming inspection, component design and evaluation, and process monitoring.

The unit offers 500 keyboard-selectable test frequencies—from 12 Hz to 100 kHz—and programmable test voltages—from 5 mV to 1.275 V. Priced from $5,500, the 1689M will be available in the fourth quarter.

GenRad Inc., 300 Baker Ave., Concord, Mass. 01742. Phone (617) 890-4900 [Circle 355]

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Semiconductors

ICs pass data at 80 kb/s over twisted pairs

With miles and miles already installed, twisted-pair wiring can give Ethernet a run for the money in wiring up digital voice and data private branch exchanges. To do this, the 64-kb/s information-handling capability of the PBXs would need to be extended to a voice-and-data terminal or work station through standard telephone lines. A pair of monolithic complementary-MOS digital-loop transceivers can be used to build a digital telephone and PBX line card that passes voice and data over 26 American Wire Gauge and larger twisted-pair cables at rates up to 80 kb/s over distances as great as to 2 kilometers.

Intended for use in digital subscriber voice-and-data telephone systems—as well as in remote data acquisition and control systems—the MC145422 and 145426 use a 256-kilobaud differential phase-shift-keying burst-modulation transmission technique to minimize radio-frequency and electromagnetic interference, as well as crosstalk. The 145422 is a master for use at the telephone switch line card, and the 145426 is the slave for use at the remote digital-telephone set or data terminal.

The master transceiver replaces the codec/filter and subscriber line interface card on the PBX line card, and transmits and receives data over the wire pair to the telephone set. The transceiver appears to the line card and backplane as if it were a pulse-code modulated codec/filter. The slave is located in the phone set and interfaces the mono circuit to the wire pair.

By hooking two transceivers back to back, a repeater can be formed. The transceivers operate using one twisted pair. Eight bits of voice data and 2 bits of signaling data are transmitted and received at each frame in a half-duplex manner: the slave waits until the reception from the master is completed before transmitting back to the master. Transmission occurs at a 256-kHz bit rate using a modified form of DPSK, permitting transmission at up to 2 km before turnaround delay becomes a problem.

The C-MOS transceiver consists of a modulator, demodulator, two intermediate data buffers, sequencing and control logic, and two data registers. It is intended to operate on a 5-to-8-V power supply and can be driven by TTL or C-MOS logic.

Available now, the 145422 and 145426, which were first announced two years ago [*Electronics,* Sept. 22, 1982, p. 125], are priced at $20.23 and $18.95 each in lots of 1,000.

Motorola Semiconductors Inc., MOS Integrated Circuits Group, 3501 Ed Bluestein Blvd., Austin, Texas 78721. [Circle 339]

256-K RAMs give designers speed, power tradeoff options

Intel's complementary high-performance MOS process has been used to produce a trio of 256-K dynamic random-access memories. The three parts, all of which are configured in a 256-K-by-1-bit format, give designers options in power consumption and performance.

The 51C256H, optimized for such high-performance, high-bandwidth applications as graphics displays, has a 120-ns access time and a Ripple-mode cycle time of 65 ns. The 51C256L is targeted at low-power applications such as portable computers and instruments. It requires a total data-retention current of only 230 μA, or approximately 1/20 the power consumption of comparable n-channel-MOS 256-K RAMs.

The third part, the 51C256HL, provides a combination of low power and high performance for applications that require both. Available now, the parts cost from $115.45 to $179.50 each in lots of 100. Samples of a part with a 64-K-by-4-bit organization will be available in limited quantities next month.

Intel Corp., 3065 Bowers Ave., Santa Clara, Calif. 95051. Phone (800) 538-1876 (in Calif., call 800-672-1833) [Circle 403]

GaAs ICs, evaluation board are now available

A total of 12 gallium arsenide semiconductor products are now available in dice form, in hermetically sealed leadless chip-carriers, or in hermetically sealed flat packages. The PicoLogic family includes four ultrahigh-speed logic integrated circuits, four counter/prescalers, and four diode and transistor arrays.

To help users evaluate the ICs, the company is also providing an evaluation board for $5,000. In lots of 100, the ICs range in price from $49 to $300. Delivery takes from four to eight weeks, depending on the part.

GigaBit Logic Inc., 1908 Oak Terrace Lane, Newbury Park, Calif. 91320. Phone (805) 498-9664 [Circle 404]

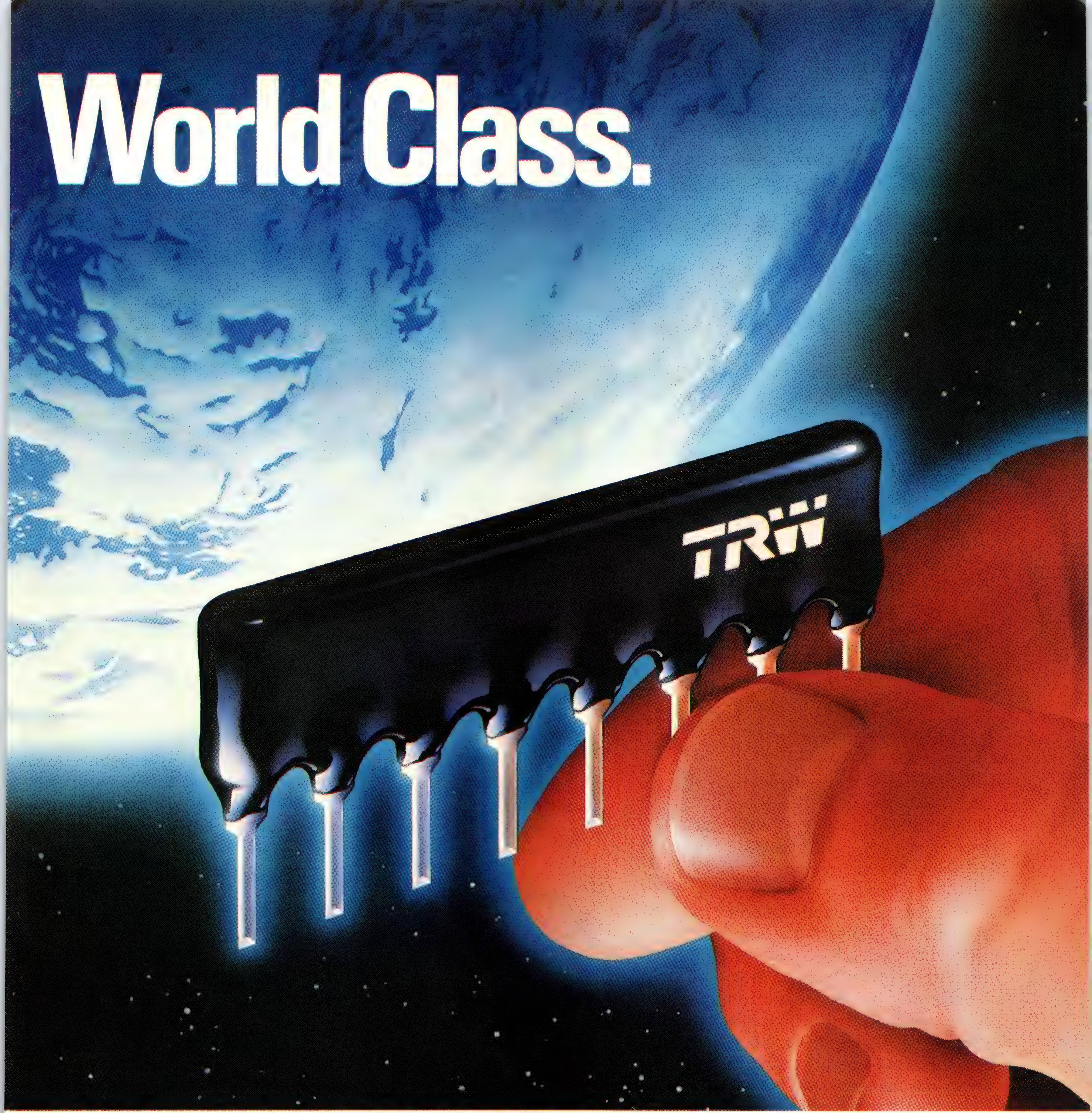
200-ns EE-PROM offers three data-protection features

Advanced Micro Devices is entering the market for electrically erasable programmable read-only memories with a 200-ns device that features a self-timed write cycle with a write time of 10 ms. The 64-K Am9864 uses a ready busy pin to indicate the write cycle's completion.

The part incorporates three data-protection features to prevent accidental writing into memory during transition states. Data is protected by inhibiting write-cycle initiation when the supply voltage is less than 3.8, by a write-enable lockout circuit that prevents write-enable pulses of less than 20 ns in duration from intiating a write cycle, and by a feature ensuring that a write cycle cannot be initiated when the output-enable control is in the logic-zero position.

When available early next year, the chip will cost $171.60 each.

Advanced Micro Devices Inc., 901 Thompson Pl., Sunnyvale, Calif. 94086. Phone (408) 732-2400 [Circle 405]



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Computers & peripherals

Copier prints 154 dots/in. in many colors

The 4692 Color Graphics Copier is compatible with several Tektronix color display terminals and can accommodate up to four simultaneous signal sources when equipped with an optional four-channel multiplexer. Incorporating the same air-assisted, drop-on-demand ink-jet technology available on previous models, the 4692 supports two printing modes. The "fixed-resolution mode" prints at 154 dots/in. addressability, while copies printed in the "variable-resolution mode" may take as little as 1 min., depending on the image format and signal source.

Designed for use with the 4692 copier, the 4510 Color Graphics Rasterizer accepts images as high-level graphics commands across a four-channel multiplexed RS-232-C serial interface. It then converts them into raster format object code, and transmits them to the graphics copier.

Available in October in three memory configurations, the 4510 rasterizer costs $4,495 for the 128-K-byte version, $5,995 for the 512-K-byte version, and $9,995 for the 2-megabyte version.

Also scheduled to be available in October, the 4692 copier lists for $5,995. The optional four-channel multiplexer costs an additional $895.

Tektronix Inc., P. O. Box 500, Beaverton, Ore. 97077. Phone (503) 644-0161 [Circle reader service number 361]

32-bit work station executes 8 million instructions/s

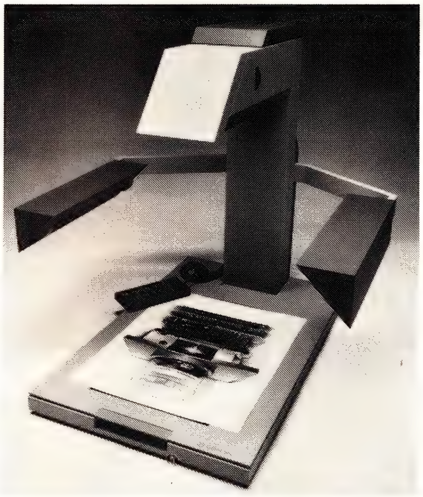
The model 32S is a single-user 32-bit work station capable of executing 8 million instructions/s. Fully software-compatible with Ridge Computers' 32C mainframe computer, the 32S can be placed under a desk or arranged as a stand-alone unit.

It offers 4 gigabytes of addressable code and data, as well as 1 to 4 megabytes of memory. The basic configuration—a Ridge 32 central-processing unit, 1 megabyte of main memory, a 78-megabyte Winchester disk drive, a 1-megabyte floppy-disk drive, and universal interfaces—costs $36,400 and is available within 90 days of order.

Ridge Computers, 2451 Mission College Blvd., Santa Clara, Calif. 95054. Phone (408) 986-8500 [Circle 364]

System with graphics scanner lets users mix graphics and text

The model 800 word image processing system, which incorporates a graphics scanner, lets users create documents with both graphics and text. Designed to operate with the



IBM Personal Computer XT as a front-end peripheral, the model 800 consists of the model 680 graphics scanner, the model 110 image-processing interface, the necessary cables, and software that runs on an XT with at least 256-K bytes of memory. Available in September, the model 800 will cost $9,945, while the graphics scanner, purchased separately, will list for $8,945.

The model 610 electronic digitizing camera lets users enter photos, documents, printed text, or three-dimensional objects into desktop computers, without using a keyboard. Available now, the camera costs $7,850 and is sold direct to system integrators, original-equipment manufacturers, and end users.

Datacopy Corp., 1215 Terra Bella Ave., Mountain View, Calif. 94043. Phone (415) 965-7900 [Circle 363]

Work station can run VM/CMS, is IBM/370-compatible

An IBM/370-compatible personal work station called the model 5400 is designed to support four simultaneous users optimally, along with four additional connections. Alternatively, up to eight devices may be connected in combinations including graphics monitors, terminals, printers/plotters, and host communications facilities.

Like the company's series 5000, the 5400 can run the IBM/370 Virtual Machine/Conversation Monitor System (VM/CMS) operating system. A 32-bit processor executes the IBM/370 problem state instruction set and also supports 4 megabytes of main and 16 megabytes of virtual memory. Every model 5400 includes a 1,200-baud modem for remote diagnostics and service.

Available now, systems start at $44,900. Designed primarily for four

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Circle 147 on reader service card

users, the 5400 costs about $10,000 per user. By contrast, the 5000 runs to about $35,000 a station.

Canaan Computer Corp., 39 Lindeman Dr., Trumbull, Conn. 06611. Phone (203) 372-8100 [Circle 362]

Units print 200 characters/s, use three 8051 processors

The 5300 line of printers includes a compact unit, the model 5310, and the 5320, with 15-in. platens for wider printing formats. The printers operate at speeds up to 200 characters/s, use three 8051 microprocessors, and the firm's MOS circuitry.

Options can be set without the keyboard, so the 5310 and 5320 can be used as full-function receive-only printers. Both utilize impact printing in a 7-by-9-dot matrix on plain paper with a choice of character sets and fonts, including those for the APL programming language, videotex graphics, and high- or low-resolution bit-mapped graphics.

Available this fall, the printers are expected to range in price from $1,315 to $1,987 for the 5310 and from $1,775 to $2,463 for the 5320.

AT&T Teletype Corp., 5555 Touhy Ave., Skokie, Ill. Phone (312) 645-8800 [Circle 365]

Nine-track streaming tape drive backs up Winchester disks

The PCT-1000 is an intelligent, compact, IBM-format-compatible nine-track streaming tape drive designed to provide 138 megabytes of backup for Winchester disks, read/write access to archival data banks, and intercomputer data exchange. The 36-lb. drive handles standard 7-, 8.5-, and 10.5-in. tape reels and a variety of formats, allowing data-interchange compatibility between computers.

Available in August, the basic price for the PCT-1000 1,600-character/in. magnetic tape drive is $2,256 when ordered in lots of 100.

Ibex Computer Corp., 20741 Marilla St., Chatsworth, Calif. 91311. Phone (818) 709-8100 [Circle 366]

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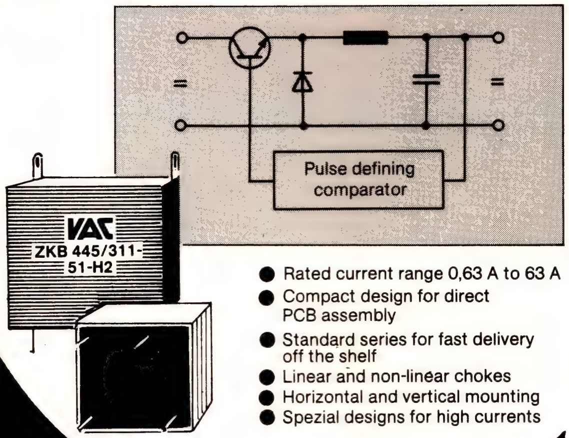

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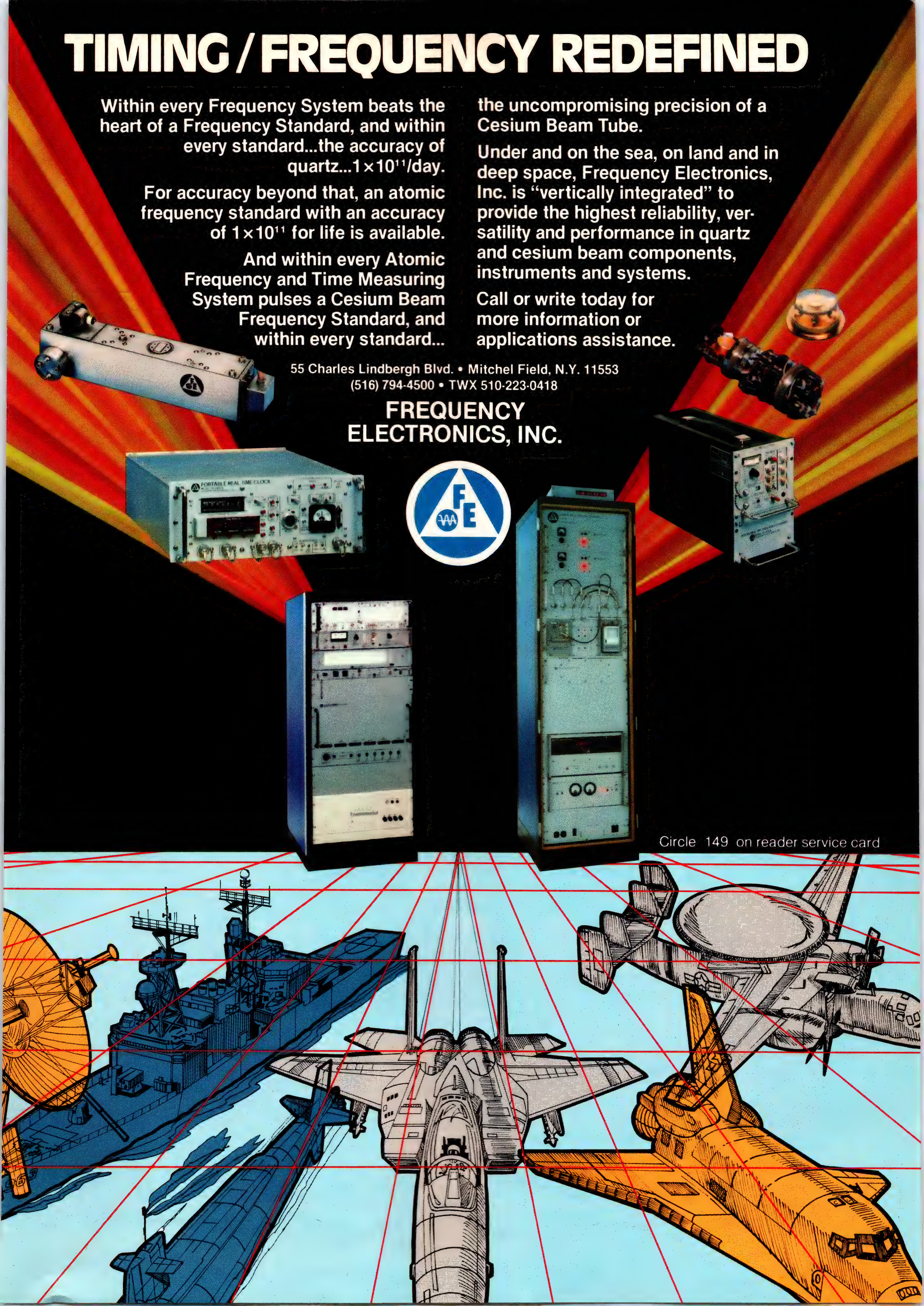

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Communications

Terminal server links Ethernet to 14 computers

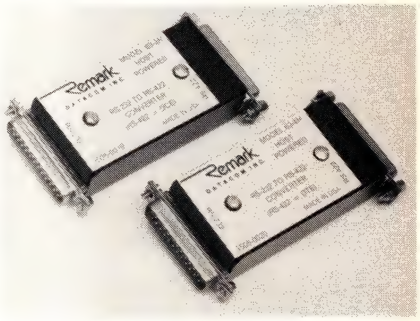
The model CS/100-14 terminal server, the latest version of Bridge Communications' CS/100, links the Ethernet local network to as many as 14 terminals or personal computers equipped with RS-232-C interfaces. The network can be expanded through the addition of more CS/100s or other models of the company's gateway servers linking remote Ethernets over X.25 public data networks or point-to-point communications links.

Incorporating a very large-scale integrated Ethernet chip, the CS/100-14 is based on a multiple MC68000 16/32-bit microprocessor design and supports the industry-standard Xerox Network System high-level protocols. The devices are connected through user command software that is loaded from an on-board floppy disk, which stores network management information, help facilities, and the logical names associated with ports for connection requests.

Available immediately, the model CS/100-14 sells for $5,400.

Bridge Communications Inc., 10440 Bubb Rd., Cupertino, Calif. 95014. Phone (408) 446-2981 [Circle reader service number 411]

Converter links RS-422 units with RS-232-C equipment



Two models of an RS-232-C-to-RS-422 converter are configured individually to operate as data-terminal or as data-communications equipment. Both the 63-3H and the 63-4H are powered from the host device through pins 9 and 10 of the RS-232-C equipment. Although users must supply +12 and –12 v, respectively, on the two pins, an internal regulator develops the +5 v that the RS-422 signals require.

Signals on the RS-232-C connector swing over the range of ±12 v, while the RS-422 balanced differential signals are in the range of 0 to 5 v. The inputs and outputs of model 63-4H reverse those of the 63-3H. Combined, both converters act as short-haul modems, transmitting and receiving full-duplex data at 100 kilobaud over as many as 4,000 ft of two twisted-pair wires.

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Both models are available from stock for $98.

Telebyte Technology Inc., 148 New York Ave., Halesite, N. Y. 11743. (516) 423-3232 [Circle 412]

Fm demodulation system works in cordless phones

The model LM3361A, a low-voltage, low-power narrow-band fm demodulation system, is designed especially for cordless telephones operating at 46 and 49 MHz. Cellular-radio units, scanners, message pagers, marine receivers, and amateur fm-radio transceivers can also use the system.

Model LM3361A includes a double-balanced mixer to reduce spurious responses and a crystal-controlled oscillator to convert input frequencies from 107 MHz to 455 kHz. A six-stage cascaded limiting amplifier performs most of the filtering and amplification, and a quadrature detector demodulates the fm signal. Because model LM3361A can operate on a supply voltage of less than 2 V, the handset requires only two battery cells. Supply current is typically 2.8 mA during the normal receive mode and 3.6 mA when the system is on standby.

Ordered in lots of 100 or more, model LM3361A is available now for $1.10 in a 16-pin dual in-line package. A 16-pin 150-mil-wide package will be offered at the end of the year.

National Semiconductor Corp., 2900 Semiconductor Dr., Santa Clara, Calif. 95051. Phone (408) 721-5000 [Circle 415]

Business system does voice, data switching on one network

A business communications system called the Rose integrates a private branch exchange, a local network, a local-network voice store and forward, text messaging and mail, and voice and data switching. An expanded version of the system is suitable for use by Fortune 1,000 companies.

Users who want to access data from a particular computer in the system can do so directly. With several keystrokes, the Teleterminal can dial the computer, automatically log on, and then display the connection on the Teleterminal's liquid-crystal display. In addition, the Rose lets users automatically return all internal and external calls by pressing one button.

Other features are simultaneous voice, data, and message transmission; name dialing, so that users can call a name just by keying it in; access to personal and system directories; and the ability to send and receive messages.

Pricing varies according to the features selected. Systems will be available sometime this month.

CXC Corp., 2852 Alton Ave., Irvine, Calif., 92714. Phone (714) 660-1801 [Circle 413]

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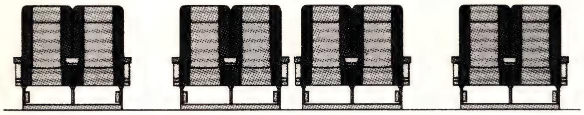

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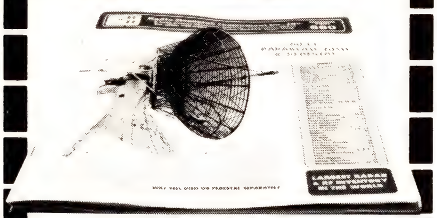

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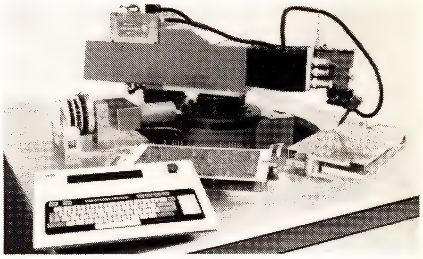
Circle 198 on reader service card

Industrial

Soldering unit teams robot, end effector



A robotic soldering system, designated the Chad ECS 201, attaches components to printed-circuit boards after wave soldering has been completed. The system, which teams an end effector and the Seiko D-Tran RT-3000 robot, achieves a repeatability of ±0.001 in.

The end effector can randomly solder a variety of component junctions, standoff pins, and compound leads without a prescribed pattern or order of soldering. Solder is fed automatically to the soldering head from a reel; the robot controls feed duration and the soldering iron's temperature. The robot moves the solder head from point to point at a rate of up to 55 in./s, and an average point can be soldered in 1 to 3 s. Housed in a steel base, the system includes the end effector, robot, and software.

Available in 10 weeks, the model ECS 201 is priced between $40,000 and $50,000, depending on the configuration.

Chad Industries, 1060-K North Batavia St., Orange, Calif. 92667. Phone (714) 997-4350 [Circle reader service number 371]

Programmable unit controls dc servo motors at 50 kHz

The model ACC40 programmable controller, intended for use with micropositioning stages, controls ministepping motors at speeds exceeding 25 kHz and dc servomotors at 50 kHz. Available with an IEEE-488 interface to effectuate computer control, the ACC40 controller will help solve many electro-optical design problems requiring both ultrahigh resolution and high-speed displacements.

The company will begin taking orders at the end of August for the model ACC40. Prices will begin at $3,000.

Klinger Scientific Corp., 110-20 Jamaica Ave., Richmond Hill, N.Y. 11418. Phone (212) 846-3700 [Circle 375]

Volumetric dispensers deliver small quantities of solder, flux

Because of their corrosion-resistant wetted surfaces made of ceramic and fluorocarbon, a line of volumetric dispensers is suitable for delivering microliter quantities of etching fluids, solvents, and acids with reproducible results of ±0.1% or better. The units use a valveless piston design that eliminates the inaccuracies of some metering pumps.

The pumps can dispense volumes from 2 to 100 microliters at a time and can achieve 600 dispenses/min. A hand/foot switch allows hands-free operation for single-shot dispensing. The unit can be used in automated equipment.

The model PiPOCKC, for 0-to-50 microliter shots, and the PiP1CKC, for 0-to-100 microliter shots, are available from stock for $450.

Fluid Metering Inc., 29 Orchard St., Oyster Bay, N.Y. 11771. Phone (516) 922-6050 [Circle 373]

VMEbus module line provides standard logical interfacing

A series of VMEbus modules has been designed around an architecture that provides standard logical interfacing for module identification, addressing, status, and control. One model, the XVME-010 systems resources module, provides all VMEbus

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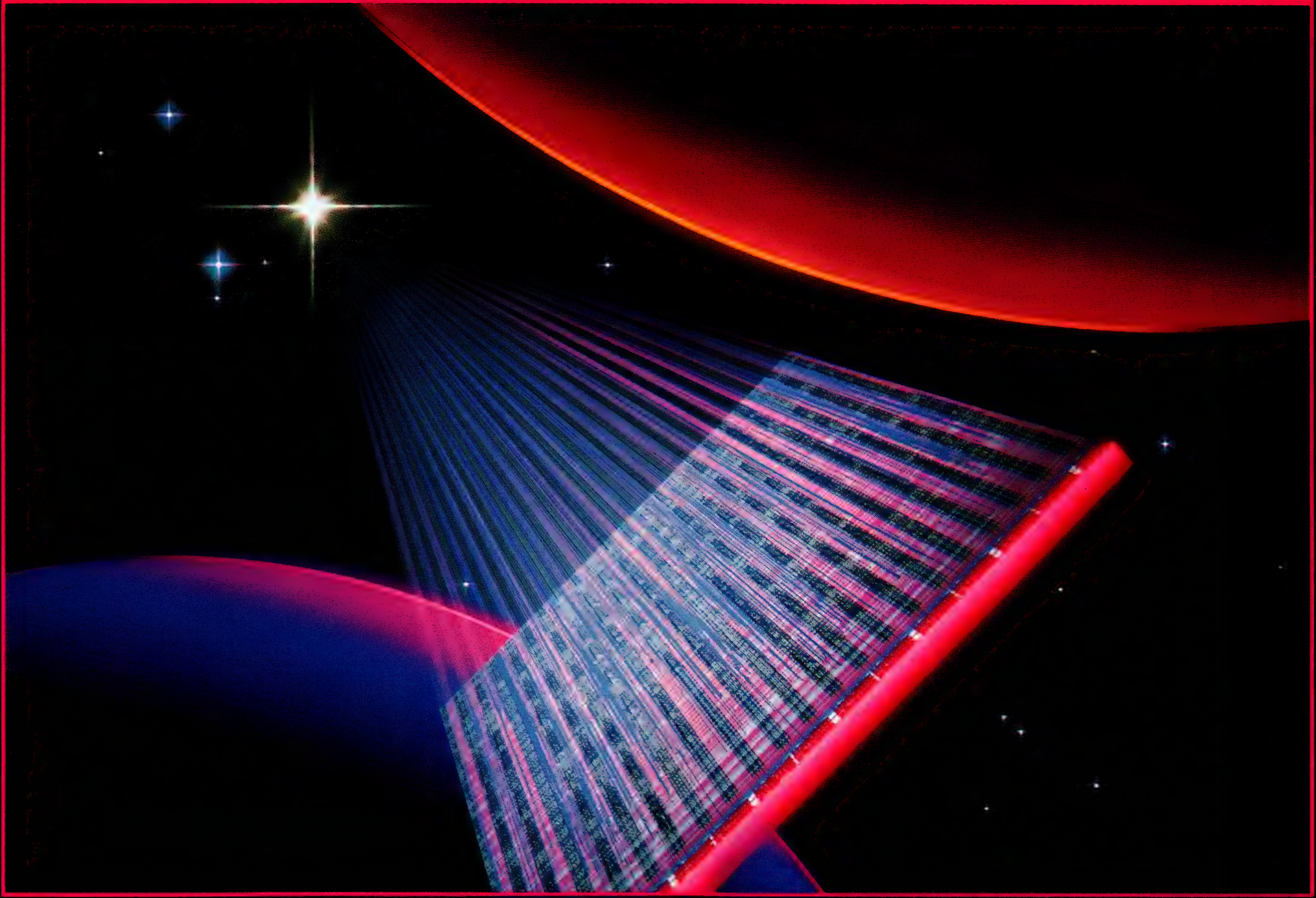

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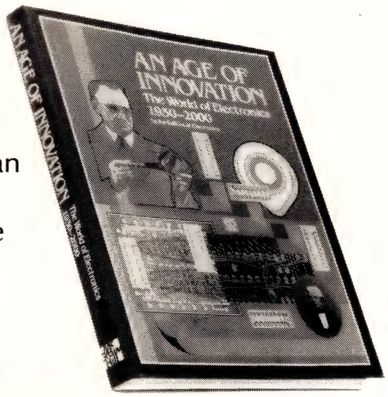

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system-utility signals, including system clock, reset, and fail.

The XVME-080 module, with a 10-MHz 68000 central processing unit, provides the user with the necessary intelligent VMEbus circuitry for designing and prototyping limited production VMEbus-based systems. The model XVME-210 board features 32 digital input channels, input signal debouncing circuitry, and opto-isolation. An intelligent-counter module, the model XVME-230, offers counting rates up to 50 MHz, eight independent counting channels, and firmware-configurable channels.

Available now, the XVME-010 sells for at $1,250, the VXME-080 goes for $1,500, and the XVME-210 for $1,050. The XVME-230 is priced at $1,900.

Xycom Inc., 750 North Maple Rd., Saline, Mich. 48176. Phone (313) 429-4971

[Circle 372]

Materials-handling unit moves 44 lbs in four directions

Featuring a variable vertical axis, the IBM 7547 is an electric-drive manufacturing system suitable for uses such as materials handling. The 7547 has a longer reach for a larger work space and twice the payload capability of the IBM 7545.

The system consists of a microprocessor-based controller with an operator panel and a jointed arm featuring four servo-controlled axes able to move the arm in four directions with a payload of 44 lbs. Thanks to the servo-controlled vertical axis, the tooling can be stopped at any point along its 9.8-in. vertical axis.

The system's control unit can store up to five distinct multiple-point routines to a maximum of 24,000 bytes of memory. The 7547 can be programmed with an IBM Corp. Personal Computer, XT, or IBM 5531 Industrial Computer using an enhanced release of IBM's entry-level robotic language. Priced at $45,000, the system is available this quarter.

IBM Corp., 1000 N. W. 51st St., Boca Raton, Fla., 33432. Phone (305) 998-3259

[Circle 374]

The best place to buy a Hong Kong factory is in San Francisco.

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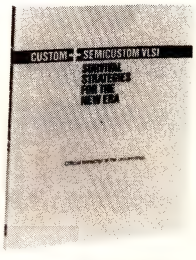

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Microcomputers & systems

Chip simplifies design of disk controllers

A floppy-disk interface is said to eliminate 60% to 70% of the TTL glue chips used in floppy-disk controller designs, bringing the total number of chips needed to build a controller down to about eight. The model µPB9201C has a phase-locked-loop and data-recovery circuit with an extremely low error rate. The digital PLL tolerates speed variations of ±4%. Adding a single volatile control oscillator to the controller expands tolerance to ±10%.

The interface circuit comes in a 40-pin plastic package, operates from a 5-V supply, and supports both 8- and 5¼-in. disks. A write clock that can synchronously switch is used to solve the problems that typically occur in switching between 5¼- and 8-in. drives. The interface generates all signals necessary for operation with the floppy-disk controller and includes drive- and head-select logic with internal buffers.

The model µPB9201C floppy-disk interface lists for $12 per unit in lots of 1,000. It is available now.

NEC Electronics Inc., 401 Ellis St., Mountain View, Calif. 94043. Phone (415) 960-6000
[Circle reader service number 431]

High-performance boards enhance VMEbus systems

Two boards are designed to make VMEbus systems more versatile. Built around the virtual-memory 68010 microprocessor, the Monoboard Microcomputer MVME 115M is a high-performance processing module designed for use as a single central processing unit in a VMEbus system or as part of a multimaster VMEbus configuration with a controller elsewhere on the bus.

With the MVME 330, a local-network controller board, VMEbus nodes can be linked on an Ethernet. The high-performance, single-board Ethernet-node-processor board is compatible with standard VMEbus and Versabus specifications and operates at 10 Mb/s. It conforms to IEEE 802.3 and Ethernet Version 2.0 specifications.

In addition to the CPU and Ethernet boards, Motorola is introducing seven other VMEbus boards and has completed a multiple-source agreement with Signetics/Philips on other VMEbus modules.

The MVME 115M is selling for $1,595, the network card for $2,600. Both are available now.

Motorola Semiconductor Products Inc., P. O. Box 20912, Phoenix, Ariz. 85036. Phone (602) 438-3501 [Circle 432]

SCSI interface for PCs links disk, tape drives

With an IBM Corp. host adapter, the IB01, owners of IBM's Personal Computer can use 5¼-in. Winchester disk drives and ¼-in. cartridge tape drives that use the Small Computer Systems Interface. The single printed-circuit board has a standard IBM PC bus interface to plug directly into a slot in the PC, the PC XT, the IBM expansion cabinet, or PC-compatible computers.

The IB01 has a protocol controller that implements the full SCSI protocol and frees the processor from implementation overhead. Using the IB01, hard-disk memory capacity may be expanded up to a gigabyte or more in a single system. The host-adapter card also includes 6-K bytes of read-only memory and 2-K bytes of random-access memory, used for storing initialization routines, configuration of the SCSI subsystem, and as a driver for handling SCSI operations.

Prices for the IB01 range from $345 to $395. Deliveries will begin in August and will take 30 days.

Emulex Corp., 3545 Harbor Blvd., Costa Mesa, Calif. 92626. Phone (714) 662-5600
[Circle 433]

Controller raises performance of 5¼-in. Winchester drives

Using an on-board 68000 processor and cache memory, a multifunction disk- and tape-drive controller allows simultaneous disk and backup streaming-tape operations. The Storager supports 5¼-in. ST506 Winchester and higher-capacity drives using the Enhanced Small Device Interface and ST412HP protocols.

As its tape-drive interface, the Storager supports QIC-02. The board uses an intelligent caching scheme to speed access times. With sector-length buffers, the 68000 can allocate on the fly the number of buffers needed by the various disk and tape devices. Available now, the Storager sells for $995 each in large lots.

Interphase Corp., 2925 Merrell Rd., Dallas, Texas 75229. Phone (214) 350-9000
[Circle 434]

Bubble-memory system resembles LSI-11 disk drive

Users of DEC's LSI-11 microcomputer systems can add a bubble-memory system without worrying about software modifications: the QBL-11/02 bubble-memory controller acts just like a DEC RL02 disk drive, but with faster access times.

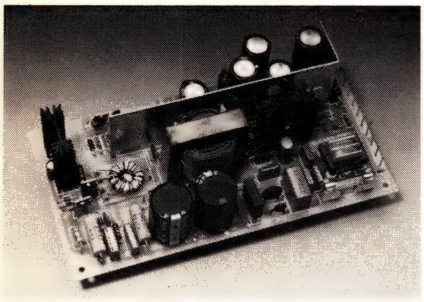
The bubble-memory system provides full emulation of the RL02 disk system, including 22-bit addressing and complete compatibility with DEC's RSX-11 and RT-11 operating systems. Storage capacity can range from 256-K bytes to 32 megabytes. Available 30 days from receipt of order, the QBL-11/02 is priced at $776 each in lots of 10.

Bubbl-Tec, 6800 Sierra Ct., Dublin, Calif. 94568. Phone (415) 829-8700 [Circle 435]

Power supplies

65-W switcher powers printers, small computers

The model SX65 65-W switching power supply features a flyback design that makes it suitable for cathode-ray-tube monitors, Winchester or floppy-disk drives, printers, and personal computers. With a low parts count, the switcher has output ratings of 5 V at 6 A, +12 V at 2.5 A, –12 V at 0.7 A, and –5 V at 0.7 A.



The unit also offers quick-disconnect connectors, overvoltage protection, and automatic current-recovery protection, and it meets many standards, including Verband Deutscher Elektrotechniker 730 and 871, International Electrotechnical Commission 380, and Underwriters Laboratories 478.

Priced as low as $52 apiece in large quantities, the switcher is available immediately.

Summit Electronics, 750 S. Sherman, Richardson, Texas 75081. Phone (214) 231-1456
[Circle reader service number 381]

Six sizes of switchers supply up to 48 V and 10 A

Designated the LV series, a line of switching power supplies comprises 30 models with single and triple outputs and comes in six sizes that supply up to 48 V and 10 A. The series features line regulation of 0.4% for input variations from 85 to 132 V ac or 132 to 85 V ac.

The series has a load regulation of 0.8% for single-output models and 2% for triple-output models. It has a ripple of 15 mV root mean square, and the company offers positive- and negative-grounded models. The temperature coefficient is 0.02%/°C for single-output and 5 V for triple-output models. For the 5-V units, minimum efficiency is 62%.

Suitable for original-equipment-manufacturer applications, the series features molex-type input/output connectors. An indicator light verifies the output voltage.

Available from stock, prices for the series begin at $19 when large quantities are ordered.

Lambda Electronics, 515 Broad Hollow Rd., Melville, N. Y. 11747. Phone (516) 694-4200
[Circle 382]

Multifunction line conditioners protect personal computers

A series of power-line conditioners combine voltage regulation, surge and spike protection, noise attenuation, and brownout protection for personal computers, memory typewriters, and point-of-sale terminals.

The series produces a low-distortion sine-wave output with a voltage regulation of ±2% for line-voltage fluctuation of +16%, –30%. Long-term brownout protection is provided to 85 V ac; noise and spikes are attenuated by a low-pass filter and electrostatically shielded transformer windings.

Pricing starts at $219 for the 150 VA model and $289 for the 275 VA model; both are available now.

Albar Inc., P. O. Box 2368, Lynnwood, Wash. 98036. Phone (206) 771-4006
[Circle 384]

Lightweight 3,000-W switchers comprise three or four modules

The PH series of 3,000-W switching power supplies provide from 0 to 300 kV at 10 mA to 0 to 3 kV at 1 A. The units, which are built from three or four interconnecting modules (depending on voltage), require only 5¼ in. of space in a standard rack.

Because PH models use air as their primary insulating medium and include no oils or potting compound, they weigh only 35 lbs per module. All the models feature both voltage and current regulation and automatic crossover to voltage or current mode, as determined by the magnitude of the load.

The series costs from $5,535, for a 0-to-10,000-V model, to $10,565, for 0-to-100,000-V model.

Glassman High Voltage Inc., P. O. Box 551, Whitehouse Station, N. J. 08889. Phone (201) 534-9007 [Circle 383]

2,000-W uninterruptibles operate from standard ac lines

Rated at from 100 to 2,000 W, Memorygard II uninterruptible power supplies operate from a standard 120/230-V-ac, 50/60-Hz power line and provide backup power with sealed maintenance-free batteries. In the event of a power failure or a line disturbance, the power supplies will provide conditioned, regulated power for computer systems. The series uses a pulse-width-modulation technique that provides a regulated output voltage of ±5% and a switching technology that features a 2-ms transfer time.

Available now, the competitively priced line of supplies ranges in cost from $495 (for a model rated at 100 VA, 115 V ac, and 60 Hz and providing 9 min of battery time) to $1,450 (for a model rated at 1,000 VA, 115 V ac, and 60 Hz and providing 15 min of battery time).

General Power Systems, 1400 North Baxter St., Anaheim, Calif. 92806. Phone (800) 854-3469 [Circle 385]

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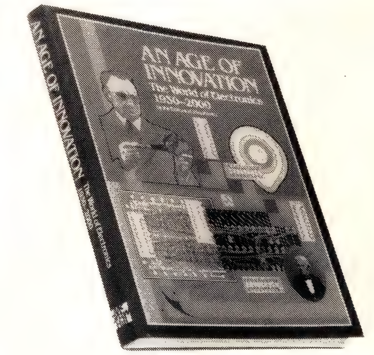

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Products newsletter

256-K C-MOS ROMs offer access in 75 ns

A line of high-density 256-K complementary-MOS read-only memories boasts access times as fast as 75 ns. Up till now, Solid State Scientific Inc. claims, the fastest access time for a 256-K C-MOS ROM was 250 ns. **The new parts' higher speed helps programs run more rapidly by eliminating wait states, even on the fastest microprocessors available today.** Currently in production with a 2-μm H-C-MOS II process, the ROMs cost less than $20 each in large quantities. Military-temperature-grade parts are available now, as are commercial- and industrial-grade models. In the fourth quarter, parts meeting MIL-STD-883 specifications will become available from the Willow Grove, Pa., firm.

Unix-based system suits DEC's PDP-11 series

VenturCom Inc., of Cambridge, Mass., has developed a Unix-based operating system for Digital Equipment Corp.'s PDP-11 series of computers. Priced at $800, **Pro/Venix is a multitasking and multiuser operating system based on Version 7 of AT&T Bell Laboratories' Unix,** and includes the Berkeley enhancements. Pro/Venix is distributed with an AT&T Technologies System 5 license to accommodate the upgrade to newer releases of Unix. DEC is targeting Pro/Venix, in combination with its Professional 350, as a work station suitable for schools, laboratories, government agencies, and technical and commercial original-equipment manufacturers.

PC storage system has hard-disk, tape drive

Davong Systems Inc.'s mass storage system for the IBM Corp. Personal Computer and PC XT teams a Winchester disk drive—available in 10-, 21-, 32-, or 40-megabyte capacities—with a 24-megabyte tape-drive backup. What's more, **the tape drive can be used either as a streaming drive for backup or as a start-stop for use as a systems device.** In start-stop mode, it acts like the hard disk in the XT. Other features of the Data-System, which is available now from the Sunnyvale, Calif., firm at prices ranging from $3,295 to $4,995, include compressed or full-volume backup, file-by-file or full-volume restore, and automatic flaw mapping.

Macintosh software combines filing, drawing

A software package called Filevision, offered by Telos Software Products, of Santa Monica, Calif., for use with the Apple Computer Inc. Macintosh computer, combines a filing system with an object-oriented drawing system. With it, for example, **a Macintosh user can draw a picture of an object and attach files of data to it for reference.** It also lets users highlight or shade objects by choosing from a pulldown menu. Filevision will be available beginning August 15 at a suggested retail price of $195.

Firm cuts prices of its PC-compatibles

Corona Data Systems Inc., Thousand Oaks, Calif., has restructured the pricing of its line of 16-bit IBM-PC-compatible desktop and portable computers and related peripherals. **The reductions range from 11% to over 20% on personal computers and from 22% to 34% for peripherals.** Corona says it is able to make the reductions because of an offshore manufacturing agreement with Daewoo Electronics Co. of South Korea. Corona has also opened a new manufacturing plant in Newbury Park, Calif., which consolidates the company's operations and expands its product range.

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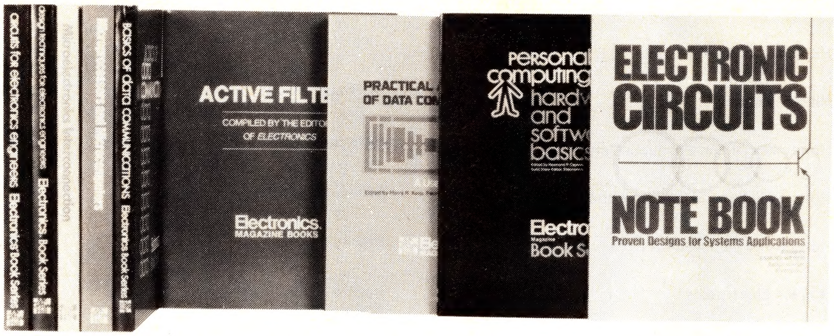
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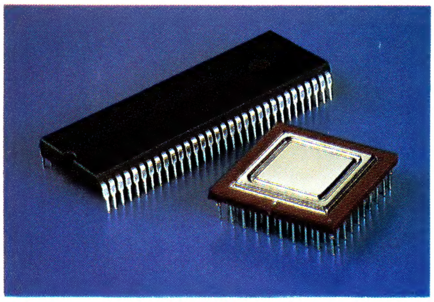

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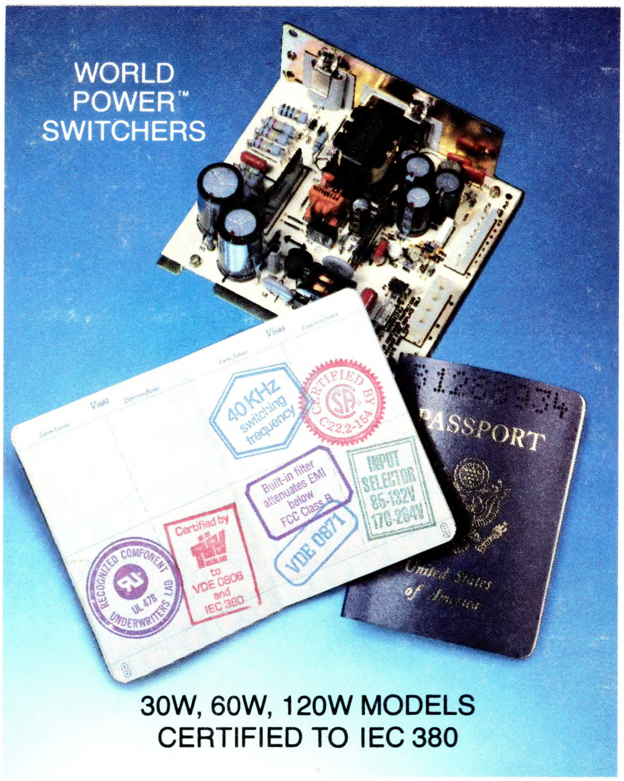
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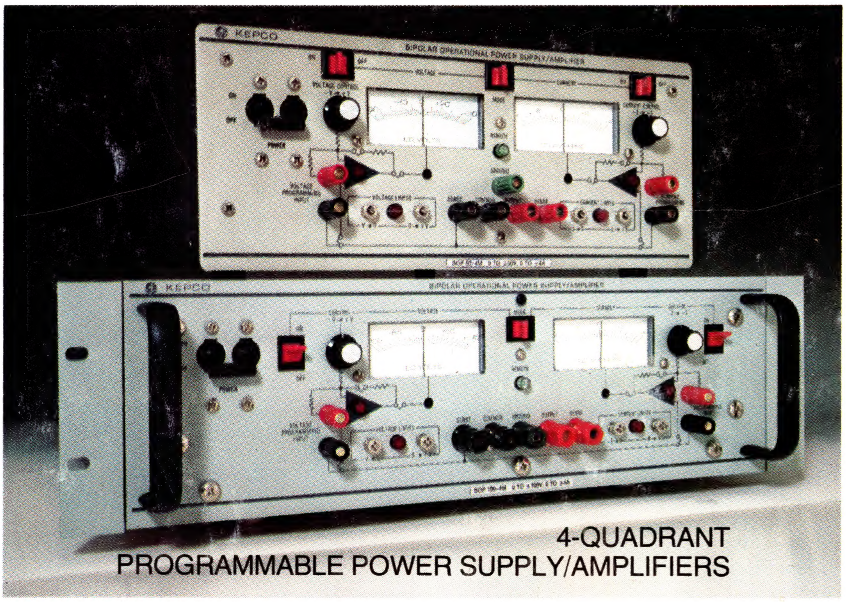
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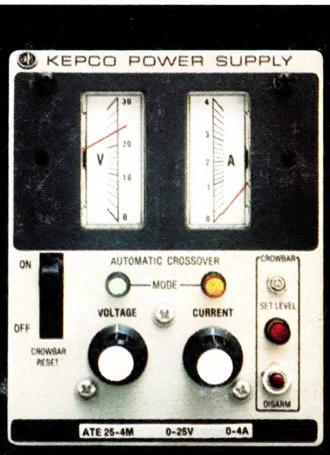

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